# AVIATION WEEK

A McGRAW-HILL PUBLICATION

November 26, 1956 50 cents


## Autopilots for:

- Jet Transports
- Business Planes

Piper's 1957 Models

## Company Formed to Study Space Design

*First in Constant Speed Drives . . .*

SUNDSTRAND

## Career-Minded Engineers . . .

### Make the right move
### Grow and Go with Sundstrand!

**CHALLENGING OPPORTUNITIES** in a fast-moving organization assure you of plenty of room for *your* growth. A sevenfold sales increase since 1950, plus a diversified program encompassing almost every type of commercial and military aircraft, assures you of *continuing opportunity* with no ceiling on your future.

**DESIGN AND DEVELOPMENT** of the newest applications of Sundstrand's constant speed drives (hydro-mechanical transmissions), hydraulic pumps and motors, gearboxes, and specialized controls demand *hydraulics, mechanical, electrical, design,* and *development engineers.*

**ROCKFORD, ILLINOIS** provides ideal living conditions, recreational facilities, and educational opportunities to complement your career, accommodate your entire family.

**GET THE FACTS**

Our new booklet,
"The Right Move,"
will give you the facts.
Write to Personnel Department,
Sundstrand Aviation,
Rockford, Illinois.
Do it today!

# SUNDSTRAND AVIATION

Division of Sundstrand Machine Tool Company, ROCKFORD, ILLINOIS  Western District Office: Hawthorne, California

**CONSTANT SPEED DRIVES · AIRCRAFT ACCESSORIES**

## No rough voyage for this Voyager!

Equipped with Terra-Tire
by Goodyear—

**aircraft lands on unimproved field with ease**

This Stinson Voyager recently swept in and made a smooth landing on a mighty rough field near Akron, Ohio.

Equipped with the new airplane Terra-Tire developed by Goodyear, the light plane was able to negotiate terrain which would spell real trouble for a conventional-tired aircraft.

But these thin and extremely pliable, baglike tires are inflated to only 3 to 8 pounds' pressure—have the ability to absorb sharp objects, "give" with them without puncturing. And the 24"-wide footpad of the Terra-Tire makes it possible for it to span pitfalls that otherwise would jolt or dump standard-equipped aircraft.

The Terra-Tire has demonstrated amazing mobility over unimproved terrain on a host of land vehicles—has proved itself on farms, sand dunes, marsh and rock quarries, has navigated delicate putting greens without breaking a blade of grass.

Now it heralds a new approach to some long-standing aeronautical problems. In addition to the Stinson application, it has been utilized in beaching amphibious aircraft along rocky shore lines.

If the Terra-Tire suggests answers to certain problems facing you right now, you're invited to write for full particulars. Address:

Goodyear, Aviation Products Division,
Akron 16, Ohio, or Los Angeles 54, California

FACILITIES + ABILITIES = EXTRA *plus* IN PERFORMANCE

GOODYEAR AVIATION PRODUCTS

Terra-Tire—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

*escape artists*

**Weber...leader in escape systems...has designed and built more ejection seats...for more operational planes...than any other independent manufacturer. Weber ejection seats are in the Boeing B-47 Stratojet...the Boeing B-52 Stratofortress...the Cessna T-37 Jet Trainer ...the Convair F-102A Interceptor...the McDonnell F-101A Voodoo. Weber leadership is no accident. Forward-looking research...most careful engineering...top-notch manufacturing... from the conception of an idea to delivery of the finished product, Weber personnel and Weber facilities are geared to do the job. For tomorrow's planes, Weber investigations today encompass ejection seats, capsules, escape systems...human factors...low altitude escape ...supersonic escape...stabilization...high altitude escape.**

**Weber Aircraft Corporation**

*2820 Ontario Street*
*Burbank, California*
*Escape systems and ejection seats*
*Aircraft interior equipment*
*Ground handling equipment*
*Aircraft sub-assemblies*

ADVERTISING DESIGNERS CO. 469

A SUBSIDIARY OF WEBER SHOWCASE & FIXTURE CO., INC.

## AVIATION CALENDAR

ov. 26-30—Human Engineering Conference, Third International Automation Exposition, Trade Show Building, New York City.

ov. 29-30—1956 Operations Research Conference, Society for Advancement of Management, Hotel Commodore, New York, N. Y.

ec. 5-7—Instrumentation Conference & Exhibit, sponsored by the Professional Group on Instrumentation and the Atlanta, Ga., Section, Institute of Radio Engineers, Biltmore Hotel, Atlanta, Ga.

ec. 6-7—Third Annual Meeting, American Astronautical Society, Hotel Edison, New York, N. Y.

ec. 7—Open House and Air Power Show, Myrtle Beach AFB, S. C.

ec. 7—Symposium on Ecology of Air Transport, Institute of the Aeronautical Sciences, 7660 Beverly Blvd., Los Angeles, Calif.

ec. 17—Annual Wright Day Dinner, Sheraton Park Hotel, Washington, D. C.

ec. 28-31—Third King Orange International Model Plane Contest, U. S. Marine Corps Air Station, Miami, Fla.

n. 21-22, 1957—Symposium on Solar Furnace Design and Operation, Hotel Westward Ho, Phoenix, Ariz.

n. 28-31—8th Plant Maintenance & Engineering Conference, Public Auditorium, Cleveland, Ohio.

n. 31—Sixth Annual Instrument Short Course, Los Angeles Harbor Junior College, Wilmington, Calif. Additional course will be held Feb. 1.

eb. 7—Operations Research Symposium, University Museum Lecture Hall, University of Pennsylvania, Philadelphia, Pa.

eb. 7—Annual Mid-Winter Symposium of the New York Section, Instrument Society of America, Garden City Hotel, Long Island, N. Y.

eb. 14-15—1957 Transistor and Solid State Circuits Conference, University of Pennsylvania, Philadelphia, Pa.

eb. 26-28—1957 Western Joint Computer Conference, Statler Hotel, Los Angeles, Calif.

ar. 7-9—National Conference on Aviation Education, Hotel Mayflower, Washington, D. C.


**AVIATION WEEK • NOVEMBER 26, 1956**
**Vol. 65, No. 22**

Published weekly with an additional issue in December by the McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication offices: 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A. Gerardi, Executive Vice President and Treasurer; Hugh J. Kelly, Executive Vice President; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publication Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; J. E. Blackburn, Jr., Vice President and Circulation Director.

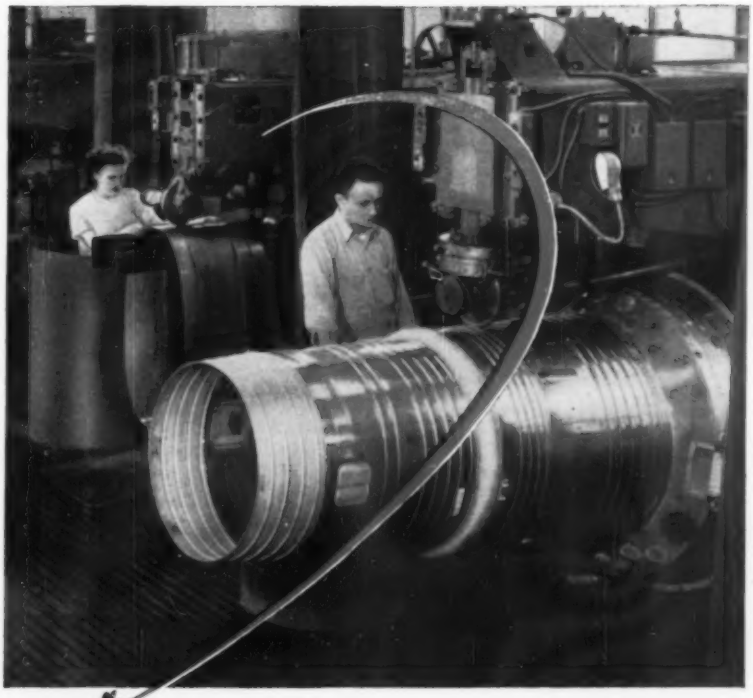
**Subscription: Address correspondence to AVIATION WEEK—Subscription Service, 99-129 North Broadway, Albany 1, N. Y. or 330 West 42nd St., New York 36, N. Y. Allow 10 days for change of address.**

**Subscriptions are solicited only from persons who have a commercial or professional interest in aviation. Position and company connection must be indicated on subscription orders.**

Single Copies 50¢. Subscription rates—United States and possessions, $6 a year; $9 for two years; $12 for three years. Canada $8 a year; $12 for two years; $16 for three years, payable in Canadian currency at par. Other Western Hemisphere and the Philippines $10 a year; $16 for two years; $20 for three years. All other countries $20 a year; $30 for two years; $40 for three years. Second class mail privileges authorized at Albany 1, N. Y. Printed in U. S. A.


Copyright 1956 by McGraw-Hill Publishing Co. Inc. All Rights Reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.





# Men, Methods and Machines teamed for CONTROLLED WELDING at Lavelle

Experienced welding engineers and technicians use individualized and advanced methods with Government Certified equipment to produce specification weldments at Lavelle. This accurately *controlled* welding insures the Grumman engine shroud shown above against the stresses of high temperature jet engine speeds . . . where peak performance proves the advantages of this specialized Lavelle fabricating service.

Lavelle fabricates weldments of titanium, high temperature resistant nickel and steel alloys and aluminum . . . by resistance, automatic or manual inert gas, metallic arc, and oxy-acetylene welding. Weld quality is *controlled* by rigid inspection using X-Ray, Zyglo, Magnaflux and microscopic procedures.

Major manufacturers depend on Lavelle's *controlled* welding to meet exacting specifications . . . Lavelle's dependable delivery to meet demanding production schedules. When your production standards require the finest in specialized fabricating services . . . contact Lavelle.

This illustrated brochure gives additional data on Lavelle services. Write for a copy without obligation.

Lavelle

LAVELLE AIRCRAFT CORPORATION • NEWTOWN, BUCKS COUNTY, PA.

*Ozark Air Lines Reports:*

# BENDIX FLUSH LOOP ANTENNA INCREASES SPEED, REDUCES PRECIPITATION STATIC 50%!

Ozark Air Lines specified the Bendix* Flush Loop Antenna in converting their fleet of DC-3's to Hi-Per modifications. And here's what Captain J. A. Wiggins, Superintendent of Flight Operation for Ozark, reports:

"Our Bendix Flush Loop Antenna installations have eliminated 50% of the precipitation static we formerly encountered. This is, of course, very important in our type of operation since a good portion of our small airport approaches are Homing facilities and it is necessary to use ADF. This is one of the modifications we are doing to our aircraft which results in an increase in speed and a decrease in operating cost."

The newest development in ADF antennas, the LPA-70, can be flush mounted on the top or lower surface of any aircraft. And because there are no projections or exposed areas, precipitation static is greatly reduced and drag eliminated entirely.

For complete information regarding performance characteristics and installation data, write directly to Bendix Radio, Aviation Electronic Products, Baltimore 4, Maryland. Or contact: West Coast—Bendix Radio, 10500 Magnolia Boulevard, North Hollywood, California; Export—Bendix International, 205 East 42nd Street, New York 17, New York.

*REG. U. S. PAT. OFF.

Bendix Radio Division

Bendix AVIATION CORPORATION

# KC-135

## BOEING

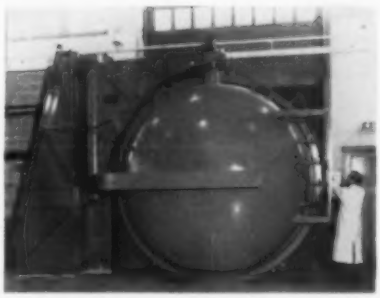
# 707

Pictured above are two of the most exciting aircraft in the world today—the Boeing 707 prototype, America's first jet transport, and her sister ship, the Boeing Stratotanker, first production model jet tanker-transport. Boeing, long-time leader in design of multi-jet aircraft, selected Twin Coach to build several major airframe assemblies for these two important aircraft.

This important assignment typifies the way prime contractors rely on Twin Coach Aircraft Division. For Twin is staffed with experienced aircraft specialists to design and construct tooling . . . with experienced aircraft production personnel . . . under experienced aircraft supervision and management.

You can buy experience—at Twin Coach. So if you're thinking of subcontracting, call Twin Coach Aircraft Division. You'll be secure in the knowledge that your assembly will be built by *aircraft specialists*—by men whose sole aim is to produce to specification . . . on schedule . . . at the lowest possible cost.

AA-4327



Twin's Aircraft Metal Bonding Dept., occupying over 35,000 sq. ft., is one of the most modern, most extensive in existence.

**TWIN COACH COMPANY** *Aircraft Division*

BUFFALO, N. Y.

*Other divisions of Twin Coach Company make:*

PONY EXPRESS TRUCKS
HIGHWAY POST OFFICES
FAGEOL GASOLINE AND PROPANE ENGINES
FAGEOL-LEYLAND DIESEL ENGINES

# Defending Today's USAF Bombers . . . .

**16 YEARS' SYSTEMS ENGINEERING EXPERIENCE BACKS B-47 AND B-52 ARMAMENT PRODUCED BY GENERAL ELECTRIC'S AIRCRAFT PRODUCTS DEPARTMENT**

**TODAY** all Boeing B-47 and most operational B-52 Air Force Bombers are equipped with electronic defense systems designed and developed by General Electric. The evolution of systems engineered bomber defense since 1940 has brought about today's completely integrated armament equipment, remotely operated by a single Air Force gunner.

# Electronic Armament From General Electric

**1940** General Electric entered the bomber armament field with amplidyne turret drives for the Consolidated Aircraft B-24 Liberator.

**1942** Boeing B-29 Superfortress was defended by the first remote-control armament system including General Electric controls and turrets.

**1944** G-E control and turrets linked with a periscopic sight allowed Douglas B-26 gunner to aim and fire both upper and lower turrets by remote control.

**1945** Standard equipment on the Boeing B-50 included an advanced General Electric, remote-controlled armament sighting system.

**1949** Convair B-36 is armed with a complete G-E defense system including turrets, sighting stations, radar control and a G-E electronic computer.

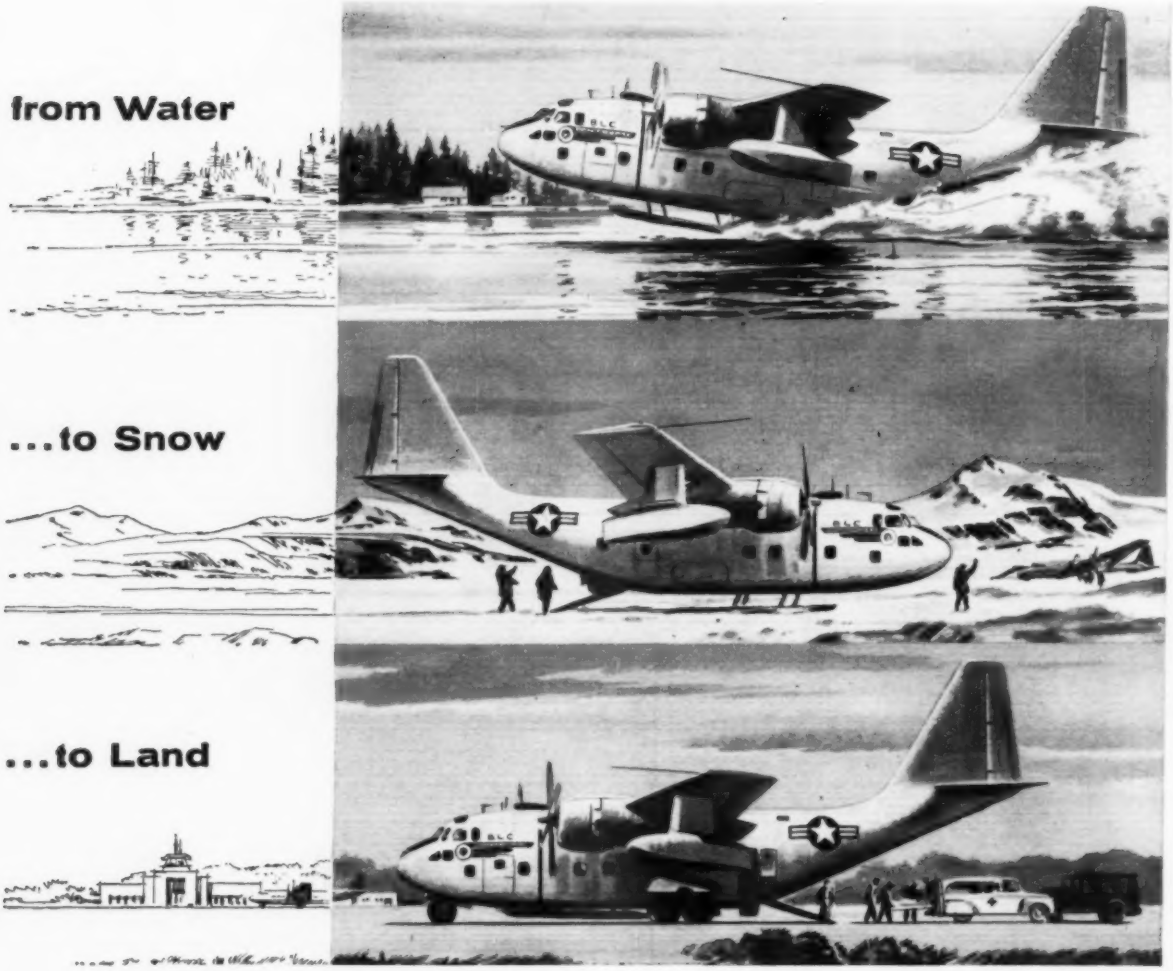
**1956** The Douglas B-66 was the first tactical bomber to be equipped with radar-directed, automatic tail armament system.

222-4

**ENGINEERS:** *Expanding electronic bomber defense projects at G.E. are creating opportunities for you. Contact C. E. Irwin, Aircraft Products Department, Johnson City, N. Y.*

*Progress Is Our Most Important Product*

GENERAL ELECTRIC




# "Mayday" Mission for Pantobase

**O**nly Pantobase equipped planes can accomplish this mission with the all-important dispatch that often makes the difference between life and death. Airplanes with Stroukoff developed Pantobase stand ready at all times to take off and land on any surface – ice, water, snow, unimproved terrain, sand, slush, mud, soft ice, or a conventional runway. No advance preparation is necessary for operation of Pantobase aircraft either in adjustments to the landing gear or in preparation of runways. *All the world is an airport.*

**A**chievement is a tradition at Stroukoff. Leaders in the development and design of cargo and transport aircraft, Stroukoff offers challenging opportunities to engineers in many fields. Send complete resume and salary requirements to our personnel manager.

STROUKOFF AVITRUC

*Extending the Frontiers of Aircraft Performance*

**Stroukoff** AIRCRAFT CORP.

WEST TRENTON, N. J.

***First***
***by performance test***

# DataTape Flight Recorder

If you want *accurate* reproduction under the most adverse test conditions, get acquainted with Consolidated's DataTape Recorder. Compact and versatile, DataTape gives you a combination of quality advantages found in no other airborne recorder.

One of many unique features is DataTape's precision and integral capstan assembly which operates under highly adverse environmental conditions with a minimum of flutter. All critical components of the tape drive system are located on a separate plate assembly to minimize vibration and warpage. A filtered capstan drive mechanism isolates the tape drive from any disturbance in the drive motor assembly. And the Recorder is provided with 9½" stiffened tape reels as further precaution against vibration.

*In recent Air Force competition tests, the DATATAPE FLIGHT RECORDER topped all others on the basis of over-all evaluation!*

*For complete information including detail photographs, write today for your copy of Bulletin CEC 1561-X19.*

## FIRST CHOICE FOR FLIGHT-TEST DATA RECORDING

**DATA CHANNELS**... 12 or 24 standard, plus 1 flutter-control track and 1 time or voice track per 12 data channels.

**TAPE SPEEDS**... 7½, 10, 15, 20, 30, and 40 in/sec.

**RECORDING TIME**... 43 minutes at 10 in/sec; 57 minutes at 7½ in/sec.

**FLUTTER**... less than 0.15% peak-to-peak (0.08% rms) over 0-to-300-cps band @ 10 in/sec. At 30 in/sec, flutter from 0-to-300 cps will be less than 0.1%. Servo flutter compensation on playback reduces this figure still further; electronic system compensates for flutter at higher frequencies.

**POWER**... 115 volts, single-phase, 50/60/400 cps; 275 watts.

**SIZE**... 7 x 22 x 11¾"; 60 pounds.

**CONTROLS, INDICATORS**... all on top plate. Warning lamps indicate data loss from mechanical or electronic failure.

# Consolidated Electrodynamics

CEC *300 North Sierra Madre Villa, Pasadena, California*

NATIONWIDE COMPANY-OWNED SALES & SERVICE OFFICES

# VICKERS.

## AIRBORNE HYDRAULIC IN-LINE RELIEF VALVES

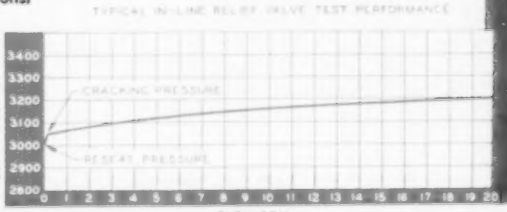
**setting a new standard of airborne relief valve performance**

Exceptionally "flat" performance, negligible hysteresis, minimum pressure sag at high temperature, outstanding accuracy and durability . . . these are the important characteristics of Vickers Airborne In-Line Relief Valves. • They have a direct-operated poppet with a high spring force (at low spring stress) available for reseating. Sliding parts are hardened steel and there are **no sliding o-rings.** A flow-compensating device permits very low differential between full flow pressure and reseat pressure . . . less than 300 psi for 150% rated flow on all sizes! • Conform in envelope to MS-28887 and internal parts have been developed to qualify in accordance with MIL-V-5523B Type II Specifications (reverse flow excepted). Adjustable to deliver rated flow over the range of 2300 to 3850 psi. • Tests at 550°F and severe vibration (25G's up to 2000 cps) indicate excellent performance under these conditions.

Write for Bulletin A 5212.

**3000 psi series. Available in ¼", ⅜", ½" and ¾" tube size (¾" not shown)**

**note low pressure change between full flow and reseat**




**VICKERS INCORPORATED**
*DIVISION OF SPERRY RAND CORPORATION*
**ADMINISTRATIVE and ENGINEERING CENTER**
**Department 1462 • Detroit 32, Michigan**

7493

*Application Engineering and Service Offices:* El Segundo, California, 2160 E. Imperial Highway • Detroit 32, Michigan, 1400 Oakman Blvd. (Service Only) Arlington, Texas, P. O. Box 213 • Washington 5, D.C., 624-7 Wyatt Bldg. • *Additional Service facilities at:* Miami Springs, Florida, 641 De Soto Drive
TELEGRAMS: Vickers WUX Detroit • TELETYPE "ROY" 1149 • CABLE: Videt
OVERSEAS REPRESENTATIVE: The Sperry Gyroscope Co., Ltd.—Great West Road, Brentford, Middx., England

*ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921*

# hytrol

*The Accepted Anti-Skid Braking System*

***hytrol*** *is standard equipment on the B-47*

***hytrol*** *is standard equipment on the B-52*

***hytrol*** *is standard equipment on the B-66*

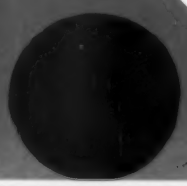
***hytrol*** *is standard equipment on the ASD*

***hytrol*** *is standard equipment on the RF-84F*

***hytrol*** *is standard equipment on the F-100C&D*

***hytrol*** *is standard equipment on the C-133A*

***hytrol*** *is standard equipment on the C-130A*



*is your airplane here?*

*Proved on Thirty-Five Other Types of Aircraft...*

*Every Fighter, Every Bomber, Every Transport is Hydro-Aire Equipped.*

**HYDRO-AIRE** *Inc.*

3000 WINONA AVE., BURBANK, CALIF.

*the aviation subsidiary of* CRANE

# BEAVERS AROUND THE WORLD

De Havilland Civil and Military Beavers
are operating in 50 different countries
on 7 continents, and from Pole to Pole.

## Countries of the World in which Beavers may be found

| | | | | |
|---|---|---|---|---|
| Alaska | Colombia | Haiti | Malaya | South Africa |
| Antarctica | Dominican Republic | Honduras | Mexico | Saudi Arabia |
| Argentina | Dutch New Guinea | India | New Zealand | Syria |
| Australia | Ecuador | Indonesia | Norway | The Philippines |
| Bolivia | Egypt | Iran | Pakistan | United Kingdom |
| Brazil | El Salvador | Italy | Panama | United States |
| British New Guinea | Falkland Islands | Japan | Paraguay | Uruguay |
| Cambodia | Finland | Korea | Peru | Venezuela |
| Canada | Formosa | Laos | Puerto Rico | West Africa |
| Chile | Guatemala | Lebanon | Rhodesia | Yugoslavia |

Designed and Built by

## THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED

POSTAL STATION "L", TORONTO, ONTARIO

WESTERN SALES AND SERVICE, EDMONTON, ALTA. — PACIFIC COAST SALES AND SERVICE, VANCOUVER, B.C.

# FREE! YOUR NEW ACTUATOR and SPLINE "PROBLEM SOLVER"!

## New 1957 Engineering Data Book from World's Largest Producers of Ball/Bearing Screws and Splines

36 pages crammed with time-, work-, and money-saving facts: Principles • Types • Basic Operations • Coupling Methods • Efficiency • Versatility • Advantages • Selection Factors • Design Data • Sample Problems, etc.

**SAGINAW b/b SCREWS** are *90%-98% efficient* (compared to 15%-20% efficiency of Acme screws). Require ⅔ LESS torque and power for same linear output—with consequent weight, space reductions. Function normally at −75° to +250° F. Two types: precision-ground or commercial rolled-thread. Have been built 1½ in. to 39½ ft. long.

**SAGINAW b/b SPLINES** have *40 times lower coefficient of friction* than sliding splines; transmit or restrain high torque loads far better; permit vital power, weight, space reductions. Have been designed 3 in. to 10 ft. long.

Saginaw ball bearing Screws & Splines

SAGINAW STEERING GEAR DIV., GENERAL MOTORS CORP., SAGINAW, MICH.

**----SEND FOR YOUR FREE COPY TODAY-----**

Saginaw Steering Gear Division, General Motors Corporation
b/b Screw and Spline Operation
Dept. 1B, Saginaw, Michigan

Please send 1957 engineering data book on Saginaw b/b Screws and Splines to:

NAME_____

COMPANY_____ TITLE_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

**SAYS** Ben F. McLeod, System Communications Engineer, Pan American World Airways System:

# "ON OVER-WATER FLIGHTS G-E 5-STAR TUBES HELP US MAINTAIN INSTRUMENT RELIABILITY!"

"Pan American's communications and navigation equipment has to be dependable on all our planes; but trans-ocean flying makes extra demands on instruments like the ones here.

"Because of our extensive overseas schedules, we attach special value to the reliability of General Electric 5-Star Tubes. Their failure rate is much lower than standard-type tubes; operating life is long; replacements are fewer.

"More and more, schedule maintenance and safety are coming to depend on the performance of electronic tubes in critical flight-instrument sockets. That's why Pan American looks on 5-Star high-reliability tubes as such a good investment."

* * *

You can install the same superior tube quality as Pan American! Phone your nearby G-E tube distributor for 5-Star types! He has them in stock. *Electronic Components Division, General Electric Company, Schenectady 5, New York.*

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

161-1E13

**FREE**

**NEW BOOKLET**

DATAFAX

Quick
Economical
Error-Free
Transmission
of
All Data

STEWART SW WARNER ELECTRONICS

*a Division of Stewart-Warner Corporation*

**SHOWING DETAILS OF**

# DATAFAX

**ELECTRONIC TRANSMISSION OF ALL DATA**

**PHOTOS • MAPS • DRAWINGS • CHARTS • TYPED or WRITTEN INFORMATION**

*Write*

**Stewart-Warner Electronics**
**Department 14**
**1300 No. Kostner Ave.**
**Chicago 51, Illinois**

For Unexcelled Reliability

# LIBRASCOPE MECHANICAL COMPONENTS

Where top performance and sustained accuracy are a "must"– specify Mechanical Components designed, developed and manufactured by Librascope.

**TYPICAL APPLICATIONS**

Provides for instantaneous solution of problems involving the sine or cosine of an angular variable. Angular rotation is converted into a displacement proportional to sine or cosine of the input.

**SPECIFICATIONS**

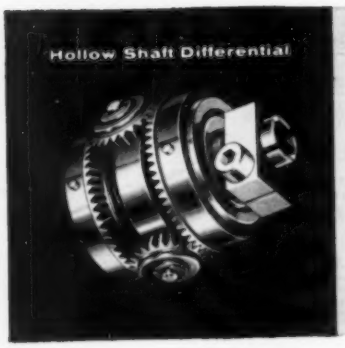
Accuracy .....0.2%
Stroke, peak to peak..1.500"
Size .....2"
Weight .....2 oz.

**TYPICAL APPLICATIONS**

A precision integrating mechanism for totalizing, rate determination and differential analyzing. Can also be used as a closed loop servo-element or accurate variable speed drive.

**SPECIFICATIONS**

Optimum reproducibility: .01% average
Force to move carriage: 5 oz. max.
Shaft travel: 1½"
Input torque: 2 in. oz. max.
Size: 1⅞" x 2¾" x 3¼"
Weight: 21 oz.




**TYPICAL APPLICATIONS**

Applicable to angular sums, angular velocity sums or sequence operations. May be installed or removed without disassembly of unit or differential. High accuracy.

**SPECIFICATIONS**

Inertia: approx. .074 oz. in.²
Max. backlash: 0° 10" at 2 in. oz.
3 point contact with spider gears.
Precision ball bearings.
Size: 1"x 1-3/16"
Weight: 1¼ oz.

LINKAGES, CUSTOM GEARS, LIMIT STOPS COUPLINGS AND CAMS precisely and promptly made to customers order and specific requirements.

*If you have a problem concerning complete computer/control systems–contact Librascope*

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

GPE LIBRASCOPE

**LIBRASCOPE, INC. • 808 WESTERN AVENUE • GLENDALE • CALIFORNIA**

NOVEMBER 26, 1956

# AVIATION WEEK

VOL. 65, NO. 22

**Editorial Offices**

New York 36—330 W. 42nd St., Phone LOngacre 4-3000 (Night LO 4-3035)
Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630
Los Angeles 17—1125 West Sixth St., Phone: MAdison 6-9351

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....Alpheus W. Jessup
ASST. MANAGING EDITOR (TECHNICAL)
David A. Anderton
WASHINGTON.....Cecil Brownlow
NEW YORK.William Gregory, James J. Dailey, Robert I. Stanfield
LOS ANGELES.Irving Stone, Richard Sweeney
ENGINEERING.....Robert H. Cushman, Russell Hawkes
AVIONICS.....Philip J. Klass
CONGRESS.....Katherine Johnsen
MILITARY....Claude O. Witze, Evert Clark
TRANSPORT....Craig Lewis, Glenn Garrison, L. L. Doty
EQUIPMENT.....G. L. Christian
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
ASST. ART EDITOR.....Robert G. Young
EDITORIAL PRODUCTION...Jerome E. Kelley
EDITORIAL ASSISTANTS
Bernie Lang, Betty Hein
LIBRARIAN.....Jeanne Rabstejnek

FOREIGN NEWS SERVICE

EDITOR.....John Wilhelm
LONDON.....William J. Coughlin
PARIS.....Robert E. Farrell
BONN.....Gerald W. Schroder
MEXICO CITY.....John H. Kearny
RIO DE JANEIRO.....Peter Weaver
TOKYO.....Dan Kurzman

DOMESTIC NEWS BUREAUS

ATLANTA 3.....601 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15.....1510 Hanna Bldg.
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....1303 Prudential Bldg.
LOS ANGELES 17.....1125 West Sixth St.
SAN FRANCISCO 4.....68 Post St.
WASHINGTON 4...1189 National Press Bldg.

SALES

ADVERTISING SALES MANAGER
E. P. Blanchard, Jr.
PROMOTION AND RESEARCH MANAGER
W. H. Jack
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS.....J. S. Costello, F. E. Bauman
CLEVELAND.....H. P. Johnson
DALLAS.....Gordon Jones, Douglas Billian
DETROIT.....C. A. Ransdell
LOS ANGELES.....C. F. McReynolds, D. T. Brennan
NEW YORK.....M. J. Storz
PHILADELPHIA....W. S. Hessey, J. D. Willis
SAN FRANCISCO.....William Woolston

BUSINESS

BUSINESS MANAGER.....J. G. Johnson
PRODUCTION MANAGER.....W. V. Cockren

RESEARCH AND MARKETING

Mary Whitney Fenton, Joan Read, Judith P. Wheeler

**Conical Camber Reduces Drag From Lift..... 26**
▶ Progressive downward curvature of wing leading edge on XB-58 bridges subsonic-supersonic gap.

**Radar Net Will Be Ready for Jet Control..... 38**
▶ Twenty-three long-range radars ordered by CAA are expected to be in operation in two years.

**Company Formed to Study Space Design..... 51**
▶ Feasibility of various approaches is investigated by Systems Laboratories Corp.

MISSILE ENGINEERING

Missile Transition Effect..... 28
Photochemical Night Glow Cause... 32
Vanguard Launching Platform..... 34
Navaho-Size Nozzle Built..... 69

AERONAUTICAL ENGINEERING

Goodyear's Inflatable Rotor..... 33
Egyptian "Dummy" MiG..... 37
Computer Shortens Data Reduction.. 60
Balloon Reaches 76,000 ft..... 62
Production Briefing ..... 66

EQUIPMENT

What's New ..... 71
New Aviation Products..... 73
Also on the Market..... 74

MANAGEMENT

Defense Modifies Payment Policy.... 26
Latins Demand Better Planes..... 29
Moss Probes Security Review..... 30
Martin Seeks Nuclear Markets..... 31
ACF Gets Reactor Contract..... 31
Who's Where ..... 23
Industry Observer ..... 23
Washington Roundup ..... 25
News Digest ..... 37

TRANSPORT

French Airline Orders DC-8s..... 30
New York Smog Study Begins..... 32
Northwest Crash Opinion..... 34
CAA to Test Runway Lights..... 34
California Eastern Orders 880..... 37
Airline International Travel..... 39
Airliner Visibility Challenged..... 40
Riddle's Cargo Business Doubles..... 41
Shortlines ..... 43
Airline Observer ..... 45
Airline Traffic—September 1956..... 47

BUSINESS FLYING

Autopilot Goes to Distributors..... 91
Pilot Cites M-185 Economy..... 93
Private Lines ..... 95

AVIONICS

Dew Line Station Finished..... 31
Autopilot for Jet Transports..... 76
Computer Service Offered..... 86
Expansions, Changes ..... 87
Filter Center ..... 87
New Avionic Products..... 88

SAFETY

Pilot Lost Airport, Crashed..... 99

Calendar ..... 5
Letters ..... 122

EDITORIAL

Focus on Latin America..... 21

**COVER:** Piper Aircraft Corp.'s 1957 business aircraft fly in echelon near the company's Lock Haven, Pa., plant. Led by the PA-23 Apache twin are the new PA-24 Comanche, PA-22 Tri-Pacer and PA-18 Super Cub. Piper expects to top $36 million in retail sales next year, not including deliveries of the new $13,500 Comanche, which will reach the field starting next April.

Picture Credits:
Cover—Gordon Vincent; 27, 37—Wide World.

67,949 copies of this issue printed

AVIATION WEEK • NOVEMBER 26, 1956 • Vol. 65, No. 22
Member ABP and ABC

**Weight-saving magnesium** sheet (white areas) is used for leading edges, empennage, wheel doors and many other parts of F8U-1 Crusader.

## 25% of external skin on record-breaking F8U-1 made with magnesium

In Chance Vought's F8U-1 Crusader, fastest U.S. fighter by official record, many precious pounds are saved by using magnesium. Designers called for a total of 166 magnesium external skin parts—25% of the wing and fuselage surface area. 275 magnesium sand castings ranging in weight from a few ounces to thirteen lbs. were used inside the skin.

Weighing one fourth as much as steel and only two thirds as much as aluminum, magnesium gives you the best combination of strength and rigidity per pound. Its stiffness-to-weight ratio is the highest of any structural metal.

Magnesium permits clean, simplified designs—eliminates many stringers and detail parts. A selection of finishes provides remarkable protection against corrosion. Machinability is excellent, too. Fabrication, fitting and joining problems are always at a minimum.

Magnesium can help you make better designs for fuselage, wings and interior parts. Sheet, extrusions, and castings can be readily produced to meet your requirements. Call your local Dow sales office, or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA363G-1.

*you can depend on DOW MAGNESIUM* DOW

# EDITORIAL

## Focus on Latin America

The Latin American Aviation Conference recently held in Miami under auspices of the Aircraft Industries Assn. Export Committee served a number of useful purposes.

First, it focused attention of North American manufacturers on the rapidly expanding export market for their products in Latin America and the increasingly stiff competition they are facing from European manufacturers in that area.

Second, it gave representatives of Latin American air forces and airlines a forum in which to discuss frankly their problems in doing business with North American manufacturers and the U. S. government. The wealth of candid detail spread before the conference on specific complaints regarding U. S. commercial and military aviation policy on Latin America was ample proof that the Latin American representatives want and need this type of channel to express their views.

As one prominent Latin American airline president told AVIATION WEEK: "The most important thing about this conference is the simple fact that it was held." The fact that 200 U.S. manufacturers, bankers, Air Force officers and State Department officials were willing to spend three days discussing these export problems was convincing proof to the Latin American representatives that at least a start has been made on a new North American attitude toward their activities.

### Key Problems

It is evident that financing, modernization and logistics support are the key problems facing Latin American air forces and airlines. Both want and need the most modern equipment available off manufacturers' production lines. The recent purchases of British Hunter fighters, Canberra bombers and Viscount turboprop airliners by Latin American countries is positive proof that, if they can't get it from North America, they will turn elsewhere to do their aircraft shopping. The irony of a British manufacturer, with a fighter program heavily subsidized with U. S. dollars through off-shore procurement, selling the same type fighter in the Latin American export market against U. S. competition, did not pass unnoticed at the conference.

In the airline business, the need for the most modern transport equipment is an essential ingredient for survival and growth. It is sheer folly to expect Latin American airlines to be satisfied with anything but the most modern and economical equipment that suits their individual needs. Robert Smith, president of LACSA, the Costa Rican airline, stated the Latin American aircraft financing problem in blunt, unequivocal terms. He pointed out that the Latin American airlines, like their North American counterparts, were facing equipment purchasing programs that surpassed the total of their net worth. As a result, they will need the same type of long-term financing methods now being used by the major U. S. carriers to finance their huge purchases of jet transports. Present policy of commercial banks, World Bank and Export-Import Bank are obsolete and useless in meeting their current Latin American airline financing problem. Mr. Smith further emphasized that Latin American airlines are playing an important role in the economic development of their region. Unless they are able to expand with modern equipment, the overall economic growth of the Latin American frontier will be retarded.

### Challenge to U. S.

Mr. Smith's proposal for the formation of a group composed of representatives from the Air Transport Assn., Aircraft Industries Assn., U. S. Air Force and U. S. private bankers to explore the possibilities of extending the same type of long-term financing to Latin American airlines as that U. S. airlines are now getting from insurance firms should be implemented immediately as the first step in formulating a more realistic financing policy for the Latin American aircraft market.

Along the same line, the Aircraft Industries Assn. cannot afford to dismiss lightly the complaints registered against the shoddy goods delivered to Latin American customers by U. S. aircraft "junk" dealers. The fact that the Latin American customers indicated they would welcome AIA functioning as a guarantee of manufacturers' reliability should be sufficient evidence to show a need for a new type of activity to protect interests of legitimate manufacturers and dealers against the inroads of the "junkies."

Proper logistic support is a much less glamorous sector than initial sales of equipment. But, without proper attention here, North American products will get a bad name for productivity. It is evident that the USAF policy of selling military aircraft at a low initial cost but without any provision for follow on logistical support needs revision.

### False Economy

Although the Latin American customer gets his equipment at a lower initial price, he generally pays more in the long run by trying to support its operation on a helter-skelter basis. We think this may be false economy. It may be much sounder to buy directly from a manufacturer who can guarantee proper technical and logistical support for a stated period and who has a vested interest in seeing that his products provide good service for the customer.

The first Latin American Aviation Conference was an unqualified success. But it was just a start on tackling what will be this hemisphere's most important aviation problem of the foreseeable future. We strongly urge that the conference be held again next year, taking advantage of the experience gained to sharpen and improve the program. We also urge that manufacturers, bankers, government officials, Air Force officers and airline executives from all the Americas continue the spirit of frank discussion of their mutual problems that was begun in Miami earlier this month.

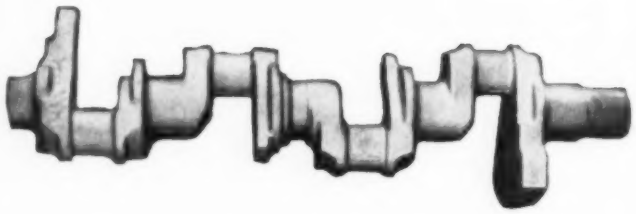
—Robert Hotz

# whether you think in terms of

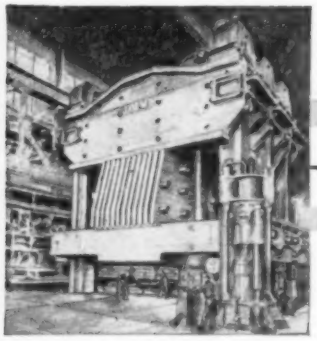
# Horsepower

# —or—

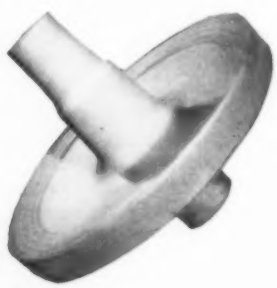
# Thrust



The crankshaft is the backbone of the piston-type engine. Illustrated above is the crankshaft forging for the most powerful piston-type aircraft engine ever produced.



At the bottom left is a turbine disc forging made from high density heat resisting alloy, and next to it is a titanium compressor wheel forging for two of the most powerful jet engines yet produced.



The history of Wyman-Gordon's contribution to aircraft progress dates from the inception of the "flying machine". The jet age is now calling on the unparalleled resources of Wyman-Gordon, which include the widest range of hammer and press equipment and the greatest technical know-how in the industry. Larger and more intricate forgings than heretofore available of aluminum and magnesium are being produced on presses up to 50,000 ton capacity, and giant hammers are fulfilling the growing need for forgings of titanium, high density materials or so-called super alloys. Now, as for nearly 75 years, there is no substitute for Wyman-Gordon experience and ability for — Keeping Ahead of Progress.

# WYMAN-GORDON COMPANY

*Established 1883*

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM

WORCESTER 1, MASSACHUSETTS

HARVEY, ILLINOIS • DETROIT, MICHIGAN

# WHO'S WHERE

## In the Front Office

**John E. Parker**, chairman-finance committee and a director of Hall-Scott, Inc., a director, Glenn L. Martin Co., Baltimore, Md.

**L. L. Waite**, vice president of North American Aviation, Inc., a director, Radio-Electronics-Television Manufacturers Assn., Washington, D. C.

**Geoffrey W. Hall**, a vice chairman, Fairey Aviation Company, Ltd., London, England. Mr. Hall is also general manager. Also: **Richard Fairey**, a vice chairman; **Robert L. Lickley**, technical director; **John C. MacPherson**, financial director; and **Alan Vines**, production director.

**Errett M. Grable**, president of Wear-Ever International, Inc., a director, Firth Sterling, Inc., Pittsburgh, Pa.

**Bernard W. Lueck**, vice president and a director, Zenith Plastics Co., Gardena, Calif.

**Arthur W. Forsberg**, vice president and plant manager, Air-Marine Motors, Inc., Amityville, N. Y.

**Albert J. Berdis**, a vice president, Olin Mathieson Chemical Corp., New York, N. Y.

**Paul M. Platzman**, vice president-sales and manufacturing, Acoustica Associates, Inc., Glenwood Landing, N. Y.

## Honors and Elections

**Dr. Edward Pearson Warner**, president of the Council of the International Civil Aviation Organization (ICAO), has been awarded the Wright Brothers Memorial Trophy for 1956. The trophy, administered by the National Aeronautic Association, has been awarded annually since 1948 "for significant public service of enduring value to aviation in the U. S."

**Harry F. Guggenheim**, president of the Guggenheim Fund for the promotion of aeronautics, **Igor Sikorsky**, helicopter pioneer, and **Grover Loening**, aeronautical engineer and inventor, were awarded certificates as "Elder Statesmen of Aviation," by the National Aeronautics Association at the annual dinner of the Wings Club of New York.

**Galen Bertram**, Southwest Kansas Aircraft Sales, has been elected president of the National Aviation Trade Association for 1957. Other officers are: **Richard R. Washburn** (southern flight service), eastern vice president; **Larry Hunt** (Air Oasis Co.), western vice president; and **J. David Finger** (Westchester Airport, Inc.), treasurer.

## Changes

**George F. Bremer**, supervisor-development planning (military requirements-aircraft engines operations), Allison Division, General Motors Corp., Indianapolis, Ind.

**J. C. Owen**, manager-advanced engineering department, and **Philip Movitz**, quality control manager, Grand Rapids Division, Lear, Inc., Grand Rapids, Mich.

**Henry W. Beardsley**, passenger sales manager-U. S., Pan American World Airways.

**Ogden C. Gorman**, European sales manager, Seaboard & Western Airlines.

# INDUSTRY OBSERVER

**► Initial test flights of the Convair B-58 supersonic bomber have indicated that it will fly supersonically at normal military power from its four General Electric J79 engines without using afterburners. The B-58 podded engine installations include afterburners on the J79. B-58 has now logged close to two hours flight time in two flights and has outrun an F-100 chase plane without using full power.**

► Studies of competitive rocket systems for ranges up to 1,500 mi. show that some current solid propellants can produce an overall system of equivalent performance to a liquid-propellant system. Solid fuel advantages include ease of logistics and handling and lower cost.

**► Best current solution to the problem of aerodynamic heating on re-entry of a hypersonic ballistic missile is to slow down the separated warhead at high altitudes—solving the problem by practically avoiding it. Heating, even for slowed shape, is still appreciable.**

► Lockheed F-104A has reached an altitude of approximately 80,000 ft. Relights have been made with the aircraft's General Electric J79 engine at altitudes of up to 60,000 ft.

**► North American Aviation's third F-107 fighter-bomber is nearing completion. Unless present procurement plans are changed, this will be the last unit built. An Air Force cut slashed the order from nine planes to three.**

► New high-energy fuel plant is scheduled for construction near Muskogee, Okla., under Navy Bureau of Aeronautics cognizance. Facility, being designed by Ralph M. Parsons Co., Los Angeles engineering firm, will be operated by Callery Chemical Co., a subsidiary of the Mine Safety Appliances Co. in Pittsburgh, pioneer in boron hydride fuel development.

**► Petrinacrylite, a new solid propellant for rocket motors, has been developed by Rohm & Haas for Army Ordnance. Performance is classified, but recent solid propellant advances have pushed specific impulse values to above the 200-sec. mark to make them competitive with liquid propellants. Specific impulses as high as 300 sec. for solid fuels are expected within the near future.**

► Ski-equipped Lockheed C-130A will be delivered to USAF in mid-February for tests at Bimidji, Minn., and in the Arctic and sub-Arctic. Requirements were originated about two years ago; work has been underway at Lockheed for the past year. "Ski-130" will be capable of carrying loads of upwards to 30,000 lb. Projected use is as a supply vehicle for the Dew Line.

**► Army's Dart missile system is expected to become an operational weapon in about 18 months. An interim-phase weapon could be obtained sooner, but the services and manufacturers have determined the false economy of the interim system, both for missiles and aircraft.**

► Brantly Helicopter Corp., Frederick, Okla., plans a larger version of its B-2 helicopter. Designated the B-3, the twin-engine, tandem-rotor aircraft will be capable of single-engine performance with six passengers. Brantly B-2, which recently completed evaluation tests at Ft. Rucker, received favorable reports from both the Army and Navy.

**► Avro Aircraft Ltd. has sent a sales team to Colombia, Brazil and Venezuela to promote its CF-100 twin-jet all-weather fighter for use by South American air forces.**

► Lockheed F-104 design, laid down six years ago, provided for sufficient ground clearance to mount an atomic bomb externally beneath the fuselage, although no such armament application has yet been ordered. Missiles can be substituted for wingtip tanks with no change in the aircraft's center of gravity.

**► Bofors, a Swedish manufacturer, is developing an underwater-to-air missile as an anti-aircraft weapon for submarines.**

## "THERE'S A BEAUTIFUL EARTH OUT TONIGHT"

These words will be spoken by a traveler from the planet Earth—and the speaker is alive today.

A whole new science of astronautics has come into being in the past decade. And today at Martin, thousands of engineering man-hours are daily being devoted to the development of guided missiles, rockets and flight systems of vital importance to the security of our country—and to the future of astronautics....It's sooner than you think!

**MARTIN**

BALTIMORE · DENVER

# Washington Roundup

## Sidetracked SWG 13

Although the report of Special Working Group 13 on air traffic control was accepted last week as a "technical document" by the Air Coordinating Committee, it still failed to obtain final approval and was sent to an *ad hoc* committee for review and "editing." Some observers fear the latest move is an attempt by the Commerce Department to water down the study before it is released publicly. First part of SWG 13 includes a blunt appraisal of reasons why airways and air traffic control development has bogged down and names the agencies it considers responsible for the retarded progress. One of the values of the report lies in the projection of these factors to ways and means of overcoming future delays in airways development. Second part of the report advocates positive control of all air traffic in certain areas. Aircraft Owners and Pilots Assn. vigorously opposes such positive control, and some quarters believe Commerce wants to by-pass the issue rather than widen the controversy by taking an official stand.

## Knowledge and Tap Dancing

One of the strongest statements yet on the amount and quality of technical training given to American students as opposed to that given to their Russian counterparts has come from Rear Adm. Hyman Rickover, assistant chief of the Bureau of Ships for Nuclear Propulsion and chief of the Atomic Energy Commission's Naval Reactors Branch. Speaking on a CBS television program, Adm. Rickover said:

". . . The Russians are out to gain the scientific and engineering leadership of the world. They have been doing this in a planned way for the last 30 years. They are devoting about 8% of their national income to education. I believe we devote somewhere about 3%, and this is a rather strange situation where a country that prides itself on having a standard of living three times as high as that of the Russians cannot afford to spend the same percentage of its income on education.

"It's generally true that people get what they want. If we think that entertainment and television . . . and movies and dances are more important for the children than education—if we think that wall paper hanging and tap dancing and baton twirling contests, paid for at public expense, are more important than to train the minds, this is what we're going to get.

"I believe that education is the most important problem that faces us today. It is even more important than atomic power . . . or than the Navy because if our people aren't properly educated in accordance with the terrific requirements of this rapidly spiraling scientific and industrial civilization, we are bound to go down.

"The Russians, apparently, have recognized this."

## ACTA Future

Air Coach Transport Assn.'s fate may be decided at the membership meeting scheduled to start today in Washington. The organization's future has been uncertain since a group of dissident carriers took over in a sudden coup a month ago. President A. J. Rome resigned, as did six of ACTA's seven directors, and the organization has been run by a committee which includes Amos Heacock, a former ACTA president.

A formal split in the ACTA membership is a good prospect as the result of the coup, and a little known air carrier organization—Supplemental Air Carrier Conference—may be the nucleus for a new airline group. SACC was organized as the Independent Air Carrier Conference in 1947 and changed its name when the Civil Aeronautics Board decided last year to issue new authority to supplemental air carriers.

The group now controlling ACTA will present its new program for the organization at this week's meeting, and new officers are to be elected. The group is basing its sales pitch on a need for more aggressive promotion of military business than was practiced by the old management. The meeting will shape the future form of ACTA, and the airlines disagreeing with this form may decide to band together under a new name, such as SACC, in their search for business.

## No Foreign Relations Change

State Department's conference of government aviation officials, airlines and aircraft manufacturers will produce no changes in U. S. policy on aviation foreign relations. The three-day meeting produced a high-level exchange of views on the Bermuda principles and other U. S. policies, and participants say the discussions were helpful.

But, while the delegates had a chance to get a number of gripes off their chests, there was general agreement that the basic principles which guide U. S. policy are sound and should be supported.

In the discussions, the airlines concentrated heavily upon the need for improved information on classes of traffic, and their efforts probably will produce more efficient gathering of statistics and more productive use of the material already gathered by the Immigration and Naturalization Service and the CAB.

These figures on traffic classes are key factors in disputes over capacity provisions in the Bermuda-type bilateral agreements the U. S. has with other nations. Accurate figures on Third, Fourth and Fifth Freedom traffic would clarify each carrier's position and help determine whether a carrier is violating the capacity provisions of its bilateral agreement.

## Postponed

Actions by two Congressional committees on aviation matters probably will be postponed until January after the new Congress convenes. Both are finding it difficult to obtain a quorum during the off-season. These are:

• **Public hearings before** the Senate Permanent Investigating Subcommittee, headed by Sen. John McClellan (D.-Ark.), on a presumed "leak" of information on the Civil Aeronautics Board's award of a Miami-New York route to Northeast Airlines. Trading of Northeast stock jumped from 400 shares on Aug. 2 to over 20,000 shares on Aug. 3, the day after CAB voted the route in a secret session.

• **Report by the Senate Air Power** Investigating Subcommittee, headed by Sen. Stuart Symington (D.-Mo.). The subcommittee held extensive public and executive hearings this spring and summer but postponed a report until after the election in an effort to have it drafted in a non-partisan atmosphere.

—Washington staff

# Conical Camber Reduces Drag From Lift

**Progressive downward curvature of wing leading edge on XB-58 bridges subsonic-supersonic gap.**

By David A. Anderton

Conical camber is a new aerodynamic design technique used in the Convair XB-58 Hustler to bridge the gap between the different requirements for subsonic cruise and supersonic dash performance.

Conical camber is a particular form of leading-edge curvature that reduces the drag of a thin wing due to its lift in the cruise condition without compromising supersonic performance. The curvature pays an extra dividend: it improves landing and takeoff performance through induced drag reduction.

Flight test results with the B-58 weapons carrier have shown a calculable increase in combat radius attributable to conical camber. The technique can be applied to any wing of swept-back planform designed for both subsonic cruise speed—up to approximately Mach 1—and supersonic dash.

The concept was derived theoretically and proven experimentally by three scientists from the staff of the 6 x 6-ft. supersonic wind tunnel of the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics: Charles W. Frick, Jr., former head of the staff and now with Convair; John C. Heitmeyer, now with Lockheed, and Charles F. Hall, now head of the tunnel staff.

The sketch of the delta-winged aircraft shows the basic idea of conical camber. It is a progressive downward curvature of the wing leading edge which increases in radius of curvature as it passes from the root chord to the tip chord.

An approximation of this kind of camber first appeared on the leading edge of the Convair F-102A when that airplane was modified extensively to improve its performance through the use of the area rule (AW Sept. 12, 1955, p. 12). Because the F-102A was a modification, the leading edge was not altered as greatly as it could have been in a new design. Future production F-102As will incorporate conical camber in the aerodynamically complete form.

The use of conical camber is aimed at reducing the induced drag component associated with the production of lift. At subsonic cruise conditions, this portion of the overall drag is substantial; it is a function only of the lift coefficient and the span loading.

For a given configuration and condition, the lift coefficient is fixed by the wing airfoil section and planform chosen. The only step that can be taken to reduce the induced drag is to adjust the spanwise load distribution to approach the ideal. That ideal is an elliptical diagram, formed by plotting the lift vectors from wing tip to wing tip. Drag is minimum when the resulting curve connecting these vectors describes an ellipse.

But the thin wings of symmetrical section used in contemporary aircraft don't produce that elliptical distribution without some modifications.

The classical aerodynamic approach to getting more lift is to increase the camber or curvature of the airfoil section. That is why sailplanes and big transports use a highly curved airfoil; the ratio of lift to drag is increased markedly as the curvature increases.

This is a good approach for the low subsonic speed range, but it won't do for high speeds in the supersonic area.

Actually camber will do the job, but it has to be a special kind of camber; the conical kind, built into the airfoil section near the leading edge.

Conical camber not only changes the lift distributions to approach the elliptical ideal, but it also swings the resultant force vector nearer the vertical to reduce the drag component of that force or lift on the wing.

Frick, Heitmeyer and Hall started to study this problem about five years ago, mostly by discussion in long bull sessions about the ways to beat induced drag. Their thinking undoubtedly had been influenced by the fact that over the years of its existence, one of NACA's major objectives has been the reduction of airplane overall drag.

Advances in techniques for cleaning up the airplane had cut parasite drag to the minimum. Whitcomb's area rule theory gave a substantial reduction in wave drag. About the only area left where work was needed was that of the drag due to lift.

The three NACA scientists, after much theorizing, agreed among themselves on some different approaches to the problem. They would split their effort along different lines. The final experimentation proved that the approach that fell to Hall—that of conical camber—was the most productive.

From there to the drawing boards at Convair was a logical progression.

# Defense Department Liberalizes Progress Payment Regulations

By Claude Witze

**Washington**—Defense Department modified its contract financing policy last week primarily to help small business firms obtain assistance when needed and provide all industry better arrangements for progress and advance payments.

At the same time, AVIATION WEEK learned, the department's Contract Finance Committee is conducting a survey to uncover industry complaints against slow payment from military disbursing offices. A questionnaire is now being circulated on which contractors are asked to report how long it takes them to receive payment on billings.

A shakeup in the progress and advance payment concept results from a recommendation of the President Eisenhower's Cabinet Committee on Small Business but is applicable to large contractors as well. Basically, the changes are designed to expedite use of progress payment clauses in contracts by making Defense Department buyers less hesitant to accept such terms.

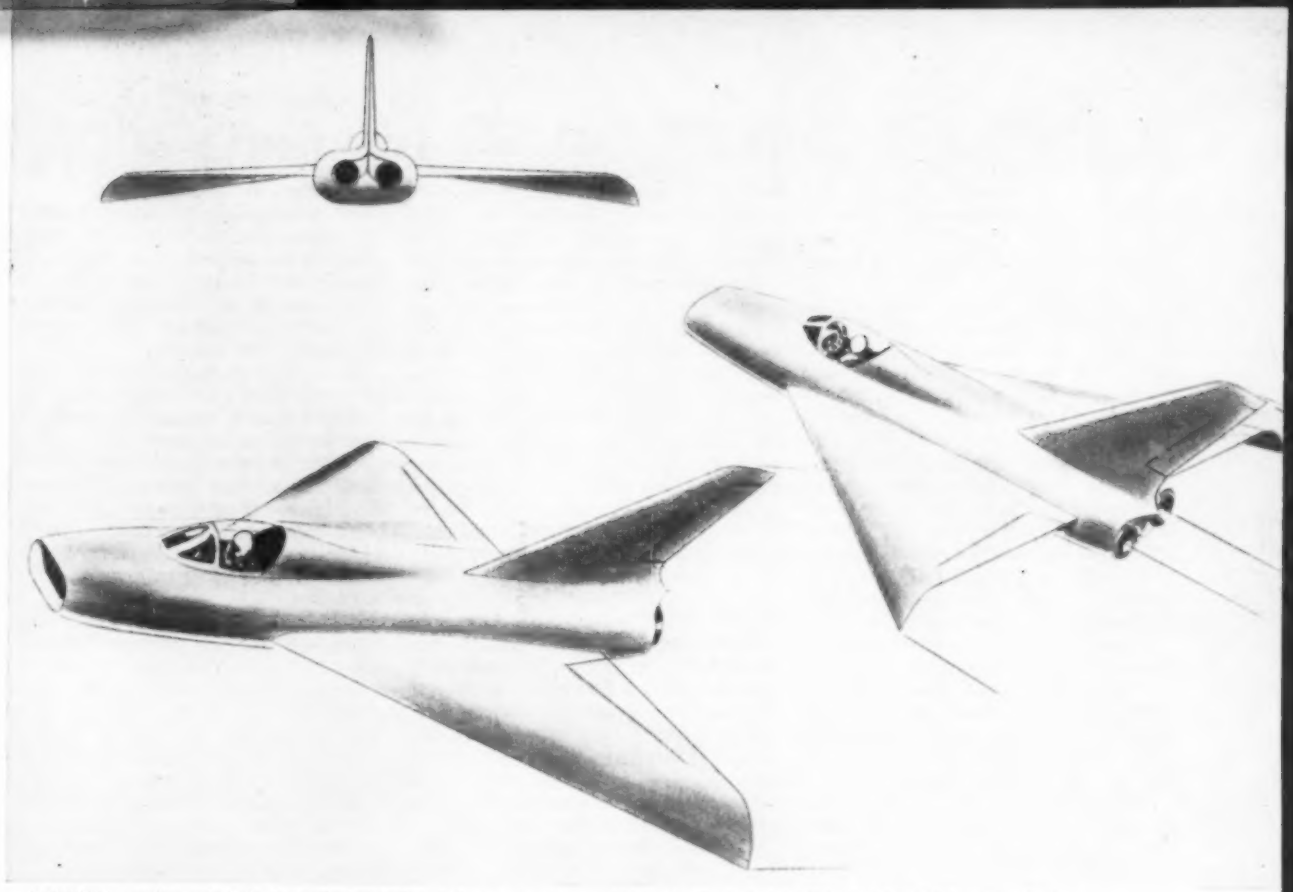
A new directive, Number 7800.4 dated Nov. 16, makes it clear that the need for advance or progress payments is not to be considered a handicap when bids on defense contracts are opened. It also emphasizes that such help is to be facilitated and speeded when requested by small business firms.

A Defense Department spokesman said this regulation has been on the books for almost five years but has been lifted from the status of a recommendation to buyers. It is now a policy. The new directive says:

"A contractor deemed reliable, competent, capable and otherwise responsible, must not be regarded as any less responsible by reason of the need for reasonable contract financing provided or guaranteed by a military department."

The Defense Department itself is expected, in these cases, to assist any financing through contract terms rather than forcing the company to use loans or credit from the outside, including the Small Business Administration.

"In bald terms," a spokesman declared, "this means the buyer must not



**CONICAL** camber principle for reducing induced drag in cruise conditions is illustrated in this sketch of delta-winged plane.

**CONVAIR XB-58** shows use of conical camber to solve high subsonic cruise condition, permit supersonic dash speeds.

hinge the award of a contract on the ability of a small firm to get a loan, from SBA or anywhere else."

In the same manner, the new directive emphasizes that the buyer is not free to turn down requests for progress payments, even in the case of relatively small deals with small business. It requires, on the contrary, that invitations for bids must specify that the need for advance or progress payments will not be a handicap to the prospective contractor.

### Past Practice

In the past, it was common for the invitation to be silent on the subject of progress payments and for a bidder to be counted out of the competition if he had included progress payments as a condition. Thus, the new directive aims to broaden the use of progress payments in advertised contracts.

It specifies that a progress payment clause will be included in the contract, if it is requested and the contracting officer finds it justified on the basis of long lead time and pre-delivery costs that must be spent by the contractor. The directive continues:

". . . Invitations for bids providing for progress payments shall also state that bids including requests for progress payments will be evaluated on an equal basis with those not including requests for progress payments."

To lend further emphasis, the directive orders that action by the contracting officer must be timely, eliminate unwarranted delay and not hesitate to make proper financing provisions. The standard calling for approval of unusual progress payments by the head of a procurement office or flag officer is waived.

When it comes to collecting progress payments, existing regulations are revised to permit the contractor to recover most of his profit as he delivers the product. The old regulation is waived again in this case, abolishing the earlier edict that fixes standards for liquidation of progress payments.

On agreement between the contracting officer and the industry, it now is possible for the contract to include more generous terms, so long as they stay within certain limitations.

On the subject of advance payments, the new directive recognizes that a small business firm may have all the accepted attributes of a good source and still lack the ability to finance its operation through orthodox business methods. If such a manufacturer has the necessary skill and is otherwise qualified, the order says, "there should be no hesitation in recommending to higher authority that advance payments be established."

### Speeds Action

The directive, in effect, tells the defense buyer not to turn his back on a company in this situation. By statute, the provision of advance payments requires approval of a service secretary or assistant secretary. This rule has not been eased, but the new directive is designed to speed action in such a case and to cut back on the rejections.

In the Defense Department, basic source of the new directive is a memorandum signed by Secretary Charles E. Wilson in September. This called for measures "to facilitate necessary financing assistance of small suppliers."

It specified that the new orders must "insure promptness in all payments on contracts when due," besides insuring that the need for advance and progress payments will not prejudice the awarding of defense contracts, the memorandum said prime contractors should be encouraged to extend progress payments to their subcontractors "whenever the need arises."

# USAF Views Missile Transition

**Washington**—USAF transition from manned aircraft to guided missile systems, scheduled to move at an increasing rate over the next four years, will bring about a basic revolution in the aircraft industry. Maj. Gen. David H. Baker, head of procurement and production for the Air Materiel Command, anticipates these major challenges to the industry:

- **Over abundance of many facilities** for manufacturing and testing as new plants are put up to replace outdated aircraft factories.
- **Less Government Furnished** Aeronautical Equipment (GFAE) and more reliance on the prime contractor to assemble a complete system.
- **Greater USAF reliance** upon scientific and engineering support from industry.
- **Greater use of automation,** new production techniques and materials.
- **New yardstick** to measure production efficiency. Cost per pound of air frame no longer will suffice.

In a speech before the Aviation Writers Assn., Gen. Baker tied several of these problems to the ever-increasing complexity of modern weapon systems and called on engineers to help solve this basic difficulty.

Indicating that industry will be called upon to provide more and more maintenance support, he also warned that, "unless industry simplifies some of the missile systems now under development, we will be unable to operate them, much less to maintain them without scientific or highly qualified engineering personnel at the operational sites themselves."

All missiles, the General pointed out, "must be reliable and must accomplish the mission on the first try." A major step in this direction can be taken, he said, by dissolving "the barriers between the design engineers and the production engineers.

Gen. Baker predicted that the need for new factories will overshadow the task of new and more accurate machine tools to fabricate missiles.

"Some of our older aircraft plants," he said, "have not been readily adaptable to missile production and have been replaced with more modern plants which over the first few years of production will more than pay for their investment.

"However," he continued, "if new plants are deemed necessary for development and production of missiles, whether paid for partially or completely by industry, the industry must plan to dispose of existing aircraft plants as new plants phase in, for, as the missile dollars increase, we can forecast ultimately a reduction in the aircraft dollars.

"This is an extremely important matter for, unless this is accomplished, we will find ourselves over-facilitized. In such an event, the high cost of maintaining and operating present aircraft plants at a low level of production will certainly strain our limited budgets, and we will find an increasing percentage of taxpayers and industry's funds going into non-productive overhead."

As an index of the speed with which the Air Force is shifting to missiles, Gen. Baker disclosed that about 8% of present deliveries are in this field, measured by their dollar value.

Three to four years from now, he said, the percentage will be greatly increased.

For the future, Gen. Baker said a major project will be the task of integrating the detection, warning and tracking of enemy weapons with the aiming, firing, guidance control and traget kill of our own weapons.

Gen Baker warned that this job will call for greater cooperation between industries.

"The Air Force can only serve as the focal point for leveling and balancing these efforts," he said, "but the major burden of accomplishment will fall to industry."

He indicated that the Air Materiel Command will continue to enforce strong dependence on subcontractors, including small business, while insisting that proper attention be paid to standardization, duplication, costs and maintenance of a mobilization base.

# Latins Demand Better Planes, Financing

**Miami**—Financing, modernization of equipment and proper logistic support were the main problems on which the 200 delegates to the Latin American Aviation Conference here focused during three days of discussion between U. S. suppliers of aircraft and their Latin American customers.

The conference, sponsored by the Export Committee of the Aircraft Industries Assn., attracted air force and airline delegations from 17 Latin American countries, plus more than 100 U.S. aircraft industry executives and bankers, USAF officers and government officials.

Among the major complaints voiced by Latin American representatives were:

- **Need for new methods** of financing Latin American purchases of aircraft and equipment with special emphasis on longer terms and lower down payments.
- **Need for modernization** of Latin America's current equipment inventory, including both military aircraft and airline transports.
- **Need for faster, cheaper** and more efficient availability of spares required for logistic support of both air force and airline operations.
- **Need for a broader assault** on the langauge barrier which now limits training and operations activities on U.S. equipment in Latin America.
- **Need for U.S. policing** of unscrupulous dealers in aircraft and parts who have delivered shoddy and unusable materials to Latin American customers.

### Inspection Needs

Latin American representatives proposed that the Aircraft Industries Assn. act as a clearing house of information for them on reputable U. S. dealers in the export market. AIA officials at the conference indicated no enthusiasm for this proposal.

Civil Aeronautics Administration representatives said they already were offering an inspection service on export equipment, but that this was no sure guarantee since material could deteriorate in the interval between inspection and delivery.

Maj. Gen. Truman H. Landon, commander of the Caribbean Air Command, told the conference one of the major problems facing Latin American air forces is the development of a reasonable, simple, inexpensive jet training plane. Gen. Landon warned that buying conventional piston engine trainers now might be very wasteful in countries with severe aviation budget limitations and warned that many jet trainer types now being built for USAF would be too expensive for purchase below the Rio Grande.

Gen. Landon also urged Latin American air force leaders to plan their military aviation requirements on a realistic basis, including the real defense needs of their country in relation to its economic assets. He warned that no nation, not even the United States, has sufficient economic resources to permit wasteful and unrealistic planning on such an expensive commodity as military airpower.

### Co-ordinating Group Urged

A plea for establishment of an Organization of Inter-American Aeronautical Co-operation (OICA) to coordinate the Western Hemisphere aviation policy was urged by the Colombian air force through its spokesman, Lt. Col. Carlos Uribe, Colombian air attache in Washington.

This new organization would function in an advisory capacity to all American nations on technical, financial and operational problems, both in the military and civil aviation fields.

Col. Uribe emphasized that the Colombian proposal was presented as a broad concept in an attempt to provide a better clearing house for inter-American aviation problems.

Col. Uribe also warned that Latin American aviation enterprises face a serious problem in the future because they are operating obsolete equipment with no guarantee of a steady supply of spare parts and replacements.

Robert Smith, president of LACSA Costa Rican airline, emphasized the phenomenal growth of 70 Latin American airlines during the post-war decade and the need for new modern equipment to continue the rate of growth for air transport that was required by the Latin American economy.

He said Latin American governments are just beginning to recognize the potential of the airborne tourist market for their economies and predicted that eventually the tourist trade will be more important to Latin America than any other single commodity.

"We are going to have to renew our domestic and international fleets at a cost several times our combined net worth," he told the conference. "We must have as efficient equipment as possible to meet the growing competition of roads, railroads, ocean liners and the competition of bigger and stronger air companies from the U.S., Canada and Europe. We can and will attract new investment capital in each of our countries without necessarily increasing government ownership.

"However, we cannot expect to meet all of our capital demands with equity issues. We must obtain financial credit from aircraft suppliers and such credit agencies as the Export-Import Bank and the World Bank, two great institutions that have done so much for Latin America in the past."

### Present Policies Inadequate

Smith warned that present policies of private banks and these two government institutions are not adequate to meet the airline financing problem and called for a new approach to the problem. He urged formation of a committee composed of representatives of Aircraft Industries Assn., Air Transport Assn., USAF and private U.S. banks to explore methods of making long-term financing available to Latin American airlines similar to the insurance company financing now used by U.S. domestic airlines to buy their new jet transport fleets.

"There is strong evidence," Smith warned, "that English, French and Russian equipment will be available under more favorable terms than American equipment. If so, that may well be a determining factor in selection of equipment for many Latin American airlines. Therefore, this is a mutual problem of primary importance for the manufacturer, the airlines and the credit institutions."

Robert Anson, general manager of SALA, Costa Rican overhaul and maintenance organization, cited cases of U.S. surplus dealers delivering unusable equipment to Latin American customers that had been deliberately puttied and painted to conceal major defects and urged that some type of "better business bureau" be established to screen legitimate aircraft and parts dealers from the "junkies" who sell shoddy goods.

## New Business Planes

**Miami—New business aircraft developments mentioned at Aircraft Industry Assn.'s Latin American Aviation Conference here included these models:**

- **Beech E50 Twin-Bonanza powered by new supercharged Lycoming 340-hp. engines is in production. This 1957 model will gross approximately 7,000 lb. and cruise at about 230 mph., approximately 30 mph. faster than the 1956 D50.**
- **Beech 95 Travel Air four-placer will gross at 4,000 lb., cruise at 200 mph. and have a range of about 1,300 mi.**
- **Taylorcraft five-placer is the latest development of the Conway, Pa., firm. Prototype is now being built and is scheduled to fly in 1957.**

# Moss Probes Security Review, Finds Abuses in Defense Agency

By Katherine Johnsen

**Washington**—Pentagon's Office of Security Review was the target of the final 1956 hearing of the House Subcommittee on Information.

After lengthy questioning, subcommittee chairman Rep. John Moss (D.-Calif.) told Joseph Edgerton, OSR director, and Lee Hargus, deputy director, that the office should properly be re-named "The Office of Security Review and Censorship."

The subcommittee postponed further hearings until January to give the staff more time to study the recommendations of the Coolidge Committee on security leaks and the recommendations of the Research and Development Policy Council on the need for an increased flow of scientific and technical information (AW Nov. 19, p. 30).

### OSR's Authority

With one recommendation of the Coolidge report, Moss took prompt and unqualified exception—that newsmen be summoned before juries, if necessary, to solve serious leaks of secret information. Instead of "merely expressing disagreement" with this recommendation, Moss said Defense Secretary Charles Wilson "should have sharply rejected the suggestion. Had I been in his place, I would have stricken out that part before signing any letter transmitting the report."

Rep. Dante Fascell (D.-Fla.) said he was skeptical of the need for an Office of Security Review after hearing Edgerton testify that:

- **Only the originating service** is capable of determining what does or does not affect security.
- **OSR has had no consolidated list** of the security directives of the three services since mid-1950—the outbreak of the Korean war. "It is just impossible to keep current," Edgerton said.

Edgerton said the value of OSR was in coordination and in "bringing about a meeting of minds" when the position on security of one service may not be accepted by another service. He admitted, however, that OSR has no authority "to either classify or declassify information."

Detailed questioning failed to develop any standard criteria used by OSR in determining whether information should be passed on to Assistant Secretary of Defense Robert Tripp Ross for review for policy considerations.

### Decision by Chance

Finally, asked by Chairman Moss whether this determination was "by chance or by system," Edgerton said it was "by chance."

The subcommittee also was critical of Ross' office and of OSR, which was organized under Ross, for invading the policy field by determining the release of information. Moss introduced two specific cases.

The first was a letter from Hargus to the Saturday Evening Post objecting to the publication of an article on Spain on the grounds that it was "a rather sneering approach to the problems and limitations of the Spanish people" and that its publication "would be considered offensive by Spanish authorities to the point that U.S. interests in Spain might be prejudiced."

Moss told Hargus that his objections were "outside your authority and highly improper." He said the article—entitled "The American Invasion of Spain" and subsequently published last Jan. 28—presented "a conscientious reporter's view of the situation." Spain, he said, recognized the critical attitude of many Americans to its regime. He added that the publication of the article "didn't cause the slightest ripple in U.S. relations with Spain."

### Protest by Gates

The second case was an Oct. 25 memorandum by Under Secretary of the Navy Thomas S. Gates, Jr., (AW Nov. 12, p. 25), which said Ross' office was passing on policy as well as the security aspects of his speeches. Directed to Ross, the Secretary of the Navy, Commander of Naval Operations, Commander of the Marine Corps and the four assistant secretaries of the Navy, the memorandum declared:

"On Oct. 23, I discussed with Mr. Ross . . . the general problem of clearance of speeches. The subject had come to my attention when I read the comments which had been submitted on two of my proposed presentations. Most of the suggestions made by Mr. Ross' office were improvements on the original text. However, as some of them appeared to be outside of the realm of security and did not appear to me to be in opposition to positive Defense Department policy, I did not know whether to take them as suggestions or as directives.

### Speech Assistance

"Mr. Ross informed me that his office makes every effort to assist us with our speeches. When appropriate, he sends them to State Department, the Atomic Energy Commission and other government agencies for advice. On occasion, he has requested comments from the Secretary of Defense and Adm. Radford. He assured me that all comments made on our scripts were merely in the form of suggestions except those dealing with security, and he agreed that all security questions would be clearly designated as such."

## AIA Attacks Coolidge Report

**Washington—Strong protest against charges by the Defense Department's Coolidge Committee that the aircraft industry is guilty of violating security in order to build up prestige has been filed by the Aircraft Industries Assn.**

**In a firm letter to Defense Secretary Charles E. Wilson, AIA President DeWitt C. Ramsey charged that industry efforts to safeguard information is made difficult by Defense Department practices.**

**Specifically, he cited the Defense Department's insistence on maintaining classification over information that cannot possibly be kept secret, such as on aircraft that are rolled out to operate in public places.**

**"It is unreasonable," Ramsey wrote, "to expect our contracting members to deny or to conceal the existence of such equipment under such circumstances."**

**The Coolidge Committee accused the industry of giving secrets to trade and technical journals and suggested tighter rules to prevent these leaks in information (AW Nov. 19, p. 28).**

**In his letter to Wilson, Ramsey called this charge "wholly unjustified." He also came to the defense of the military services and the press, which shared the blame in the opinion of the committee.**

**Ramsey said it is a fact "that current practices of the Department of Defense in the security of information are such that there is no consistency or uniformity in the implementation of policies and directives.**

**"This tends to break down the entire system of security of information and places our member companies in difficult, and often embarrassing, situations."**

**On the subject of the trade and technical press, Ramsey told Wilson that "most of these writers are experienced people who are perfectly capable of drawing their own conclusions, sometimes on the basis of partial information."**

## Martin Seeks World Nuclear Power Markets

**Baltimore**—Glenn L. Martin Co. announced the formation last week of Martin International, a wholly-owned subsidiary, to develop world markets for nuclear powered electrical generating systems.

George B. Shaw, vice president for procurement and previously the director of commercial sales, was named president of the new subsidiary.

Martin already has negotiated a contract for an atomic plant with the Dominican Republic to increase Ciudad Trujillo's generating capacity from 45,000 to 57,000 kilowatts. Negotiations have been opened with Cuba and Brazil. Martin's sales campaign is concentrating upon countries dependent on "fossil fuels"—coal, oil, and gas. The company is emphasizing power systems with a production capacity of from 10,000 to 15,000 kilowatts in its development program which has been underway for three years under military contracts.

## ACF Industries Gets Reactor Contract

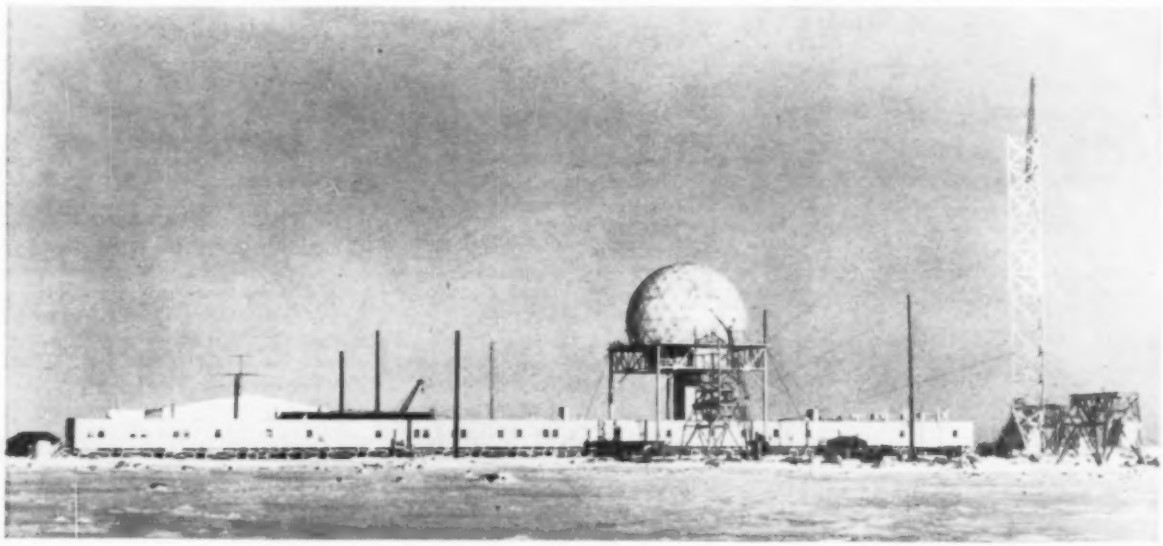
**Washington**—A 10 megawatt water cooled reactor for the Air Research and Development Command's Nuclear Engineering Test Facility at Wright Air Development Center will be designed and fabricated by the Nuclear Energy Products Division of ACF Industries.

First operation is planned for mid-1958. One major task for the reactor will be technical test support for Air Force's WS-125A nuclear bomber (AW Aug. 6, p. 173).

Irradiation cells on two sides of the reactor will include environmental chambers capable of simulating high altitudes for studying the behavior of material and components under varying thermal and radioactive conditions.

ACF will design, fabricate, supervise construction, prepare a safeguard report and instruct USAF personnel in operation of the reactor.

ACF is a subcontractor to Maxon Construction Co., Inc., of Dayton, which holds the prime contract from Army Engineers. This is the fifth research reactor sale for ACF's nuclear division in less than a year. Although the 3,000-man division is about six years old, most of its work in the past has been on classified projects. The reactor branch was formed just over a year ago.



## First Dew Line Station Finished

**First Dew Line radar station has been completed and turned over to Federal Electric Corp., which will operate and maintain the chain of Arctic radar stations. USAF spokesman says Western Electric, which is building the Dew Line, is ahead of schedule. Radar is housed in new type of plastic radome designed specifically for Arctic use. The radome (closeup right) is built up from diamond-shaped pieces of reinforced fiberglass. Construction technique for radome was developed by Geodesic, Inc.**

## Photochemical Cause Of Airglow Proved

Fluorescence of sodium vapor released from an Aerobee-Hi in the upper atmosphere has proved that night airglow is generated by a photochemical process. The test climaxed a five year study of the elusive light which occurs even when direct or reflected rays from the sun and stars are absent.

The study has been made by the Geophysics Research Directorate of the Air Force Cambridge Research Center and has involved four Aerobee firings and numerous laboratory experiments. Results were fairly well established by earlier tests (AW Aug. 6, p. 138), but possible direct influence of the sun had not been eliminated and reacting chemicals had not been completely identified. First tests used nitric oxide instead of sodium vapor.

In the recent firing, sodium vapor was streamed from an altitude of 30 mi. to the top of the rocket's trajectory at 85 mi. and back down to an altitude of 40 mi. The reaction upon the sodium vapor of solar energy stored photochemically between 30 and 60 mi. produced a bright yellow glow. Above 60 mi. there was no reaction. No direct or reflected sunlight was present.

Experts believe the fundamental knowledge gained from the study will be very important to aeronautics, but immediate applications are uncertain. It has been suggested that the ionized gas clouds could be used as reflectors for more reliable scatter communication. Another idea is that they may be used for local illumination in combat areas.

## New York Airport Smog Is Surveyed

**New York**—Importance of air pollution in reducing airport visibility is under study by New York University in a project sponsored by Flight Safety Foundation.

Comparison of conditions at New York International, LaGuardia and Newark Airports with those at Westchester County Airport, where air is clearer, will be recorded over a period of at least a year by the university's College of Engineering researchers.

First field studies began last week with visual observations from a Port of New York Authority Bell 49G helicopter of smoke and smog conditions at the metropolitan airports.

Sampling stations will be set up at the three airports for recording air pollution concentrations. According to the university, it is known that pollution causes fog to persist longer than it does in clean air, but hitherto no systematic study has been made in the New York area.

## New Film Processor Developed for USAF

**Baltimore**—A photographic processor that develops each negative individually on a roll of aerial film has been developed for the Air Force.

Until now, rolls of negatives were processed on an average development time, resulting in the loss of valuable reconnaissance data on below-average negatives.

The Houston-Fearless Division of the Color Corp. of America built the 24 ft. long, 6 ft. high prototype under the direction of the Air Research and Development Command's Wright Air Development Center. Later machines will be smaller. Eastman Kodak Co. contributed what ARDC called "a radically new type of aerial camera film" to be used with the processor.

The processor handles films from 200 to 400 ft. long and can process some 3,000 negatives a day. It is air transportable when disassembled. Here is how the processor works:

- **Pre-development chamber.** Film is threaded over rollers which guide it through the processor at 5 ft. per min. It is treated first in this chamber and a partially developed picture is brought out. Development is then halted by a stop bath.
- **Scanner section.** An operator using an infra-red viewer and light source can examine each negative and set in additional development or allow the film to move on for automatic determination of this question.
- **Electronic evaluator.** Here an infra-red beam scans each negative to determine its lightest portions and decide how much, if any, further development is needed.
- **Programmer.** Information from the electronic evaluator is fed to the programmer, which assigns one of 396 rotating cams to each negative. The cam controls treatment of the negative as it moves through the variable development section.
- **Variable development section.** Here each negative is developed by a developer spray in an individual compartment which is the same size as the negative. A number of negatives can be treated at a time, each isolated from the next. The sprays can use either water or developer, depending on need.

When the film leaves the development section, it is sprayed with short stop solution, hypo and water. It then moves past a window where each negative can be reviewed.

Finally it travels back through the lower part of the machine, where hot air blowers dry it before respooling.

C. T. Lindhorn of WADC's Aerial Reconnaissance Laboratory is project engineer for the new processor.

# High-Speed Radiosonde Developed

**Baltimore**—A cheaper, more accurate and adaptable radiosonde for use at altitudes of up to 60,000 ft. and speeds up to Mach .98 has been developed by the Air Research and Development Command. It is now being standardized for Air Force use.

The radiosonde is used to determine temperature, humidity and air pressure in remote areas where there are no permanent weather stations.

The improved model, which costs $80 as compared with $100 for the earlier model, was developed by Wright Air Development Center's Aerial Reconnaissance Laboratory. It was flight tested from 1954 until this year. The radiosonde is 2½ in. long, 5 in. in diameter and weighs 9 lb.

Limits on the earlier model were Mach .43 and 30,000 ft. Reliability on the newer version is 95% as compared with 80% in the earlier model.

Seven Air Force weather squadrons drop some 25,000 radiosondes each year in the northern hemisphere, primarily over oceans and polar regions. Data radioed to a plane during the drop is decoded, recorded, evaluated and radioed to a central weather station for use on a world wide weather network.

**NEW RADIOSONDE developed by ARDC is adjusted for pressure setting by Wilson A. Maxim of Wright Air Development Center Aerial Reconnaissance Laboratory.**

**LIFTING** characteristics of Airmat fabric rotor blade will be studied by Goodyear Aircraft Corp. engineers after mounting on GA400-R Gizmo one man helicopter. Tests are scheduled to begin early next year.

# Goodyear Develops Fabric Rotor Blades

**Akron, Ohio**—Goodyear Aircraft Corp. is developing fabric rotor blades for helicopters and convertiplanes under a Navy Bureau of Aeronautics contract. Tests on a GA400-R Gizmo one man helicopter are scheduled to begin early next year.

Goodyear already has demonstrated the principle of woven inflatable structures with airfoil contours, in its collapsible airplane (AW Feb. 13, p. 39).

Goodyear also is working on a Wright Air Development Center contract to determine basic fabric properties necessary to meet load and fatigue requirements of helicopters. One aim of this work is a flight demonstration with a large blade design.

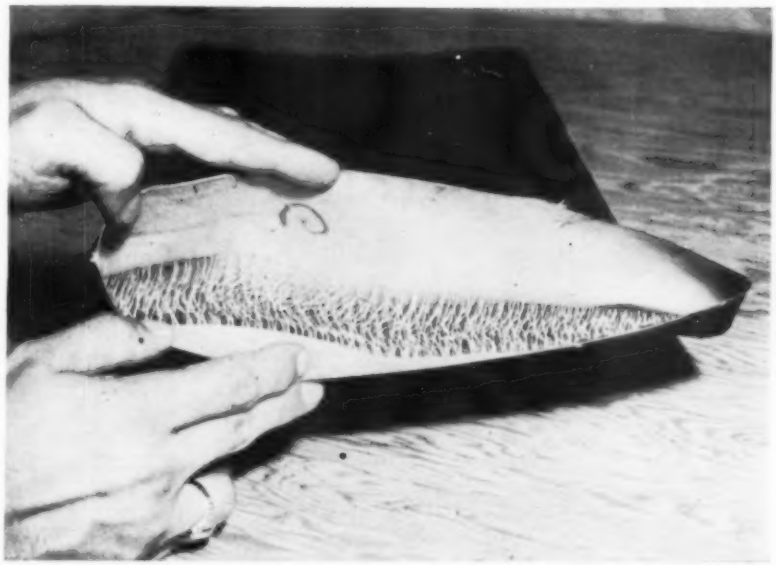
The inflatable structure, called Airmat, was developed by Goodyear Aircraft and Goodyear Tire & Rubber Co. fabric engineers.

Two basic layers of high strength cloth are woven simultaneously with drop threads interconnecting them. Length of the drop threads determine contour. The cloths are then coated, and cover layers are applied to obtain pressure-tight surfaces of the desired strength.

Airmat would permit a minimum storage area, allow for high production rates and a corresponding low cost, Goodyear said.

As a rotor blade, it utilizes both surface tension developed by the inflation pressure and tension added by centrifugal forces. This permits use of low inflation pressure during operation. Therefore, by using a relatively small accessory compressor, there is the possibility of retaining lift in the event of a blade puncture.

Airmat also will revert to its original shape and utility if design limits are exceeded and "failure" occurs, Goodyear said.



**OPEN** end view of Airmat fabric shows drop threads between fabric layers.

## CAA Will Test New Runway Surface Lights

**Washington**—Civil Aeronautics Administration will flight test three experimental runway lighting systems at Andrews Air Force Base, Md., in hope of establishing definite U. S. civil-military standards by next March.

Tests will begin in December, at which time installation of an ILS system and high intensity approach lights will have been completed to permit practical use of the new lights.

The three systems are designed to eliminate the darkened, or "black pit," look of a runway surface which appears to a pilot during flare-out of an airplane following approach under high intensity lights. Each system clears the darkened areas by putting illumination on the runway itself.

Two of the systems involve high intensity lights set into the runway, and are arranged to appear to the pilot as bars of light. One system, developed by Dutch Elfalka, uses steel bars as a protection against airplane impact. The other, a British development, employs a protective cast iron hood.

The third system is a Sylvania Electric unit that illuminates the surface from the side of the runway. Newly-developed high-power fluorescent tube-mounted reflectors are set on the runway edge. Reflecting-paint in checkerboard design on the runway surface is expected to improve the efficiency of the edge-lighting system.

**Vanguard Launching Platform**

**Platform for Project Vanguard artificial satellite serves both as a launching device and a static test stand for the three-stage rocket. First stage develops a thrust of 27,000 lb. Stand, designed and built by Loewy-Hydropress Division of Baldwin-Lima-Hamilton Corp., is about 15 ft. square and stands 11-12 ft. high. It incorporates a 7-8 ft. diameter water-cooled throat to turn the first stage rocket's exhaust 90 deg. from vertical to horizontal. Loewy, which made the stand under subcontract to Glenn L. Martin Co., is also in charge of complete instrumentation for the stand, its support mechanisms, utilities, and all associated research, such as heat stress analysis.**

## Northeast Asks SEC For Stock Sale Permit

**Boston**—Northeast Airlines last week filed a registration statement with the Securities and Exchange Commission in a move to raise $7 million net capital through the sale of additional common stock.

The offering, underwritten by a nation-wide group headed by Carl M. Loeb, Rhoades & Company, is planned for mid-December.

The underwriters propose to offer stockholders other than those of the Atlas Corp., the majority stockholder, new stock proportionate to present holdings. The general public will be offered 50% of the new issue. Atlas Corp. has agreed to purchase from the underwriters all remaining stock and any shares offered but declined by stockholders.

Proceeds from the stock sale, together with funds made available through an $11 million bank credit agreement, will give Northeast $18 million for use in its expansion and equipment purchasing programs.

## Stratocruiser Ditched, NWA Crew Blamed

**Washington**—Civil Aeronautics Board reports that a Northwest Airlines Stratocruiser was ditched in Puget Sound last April because the crew incorrectly analyzed a control difficulty that occurred after takeoff.

The CAB said the crew was forced to make the analysis under conditions of great urgency and in an extremely short period of time.

The Stratocruiser accident occurred four minutes after takeoff from Seattle-Tacoma Airport.

When the aircraft reached an altitude of 1,000 ft. and wing flaps were retracted, severe buffeting was encountered.

The Stratocruiser became difficult to control, and the captain decided to make an emergency landing at McChord Air Force Base. However, as the trouble continued and the aircraft lost altitude, the captain decided to ditch.

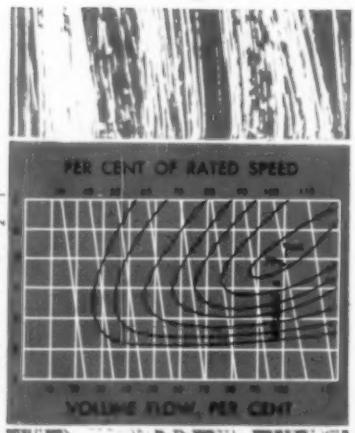
The ditching was made on smooth water.

All 32 passengers and the crew of six left the airplane. Four passengers and one crew member drowned before rescue craft reached the scene. The Stratocruiser was a total loss, although it was later raised from the bottom of the Sound.

The Northwest transport encountered buffeting at the time the wing flaps were retracted. The Board found that this buffeting was due to the fact that

# The Heli-Rotor Compressor

## Surge-free • Efficient • No Containment Problems




Now available for aircraft applications is a new type of rotary-positive displacement compressor offering these advantages:

- High specific delivery at high speed – up to 42000 rpm. Capacities 25 scfm to 25,000 scfm.
- High pressure ratios in single stage (up to 10:1) from small compact units.
- Surge-free operation with compression ratios independent of speed.
- High efficiencies resulting from built in pressure ratios.
- Suitable for high temperature operation – suitable for air, freon and other gases.
- Simple construction – simple control systems.

Heli-Rotor compressors are adaptable to a variety of drives: hermetically sealed electric, turbine, hydraulic or direct from an engine. The design of the Heli-Rotor compressor assures unusually long and trouble-free service life. Individual compressors have operated without stopping for as long as 3 years.

In these units, two helical lobe rotors trap the entering gas, compress it and deliver it to an exit port at design pressure. Two-stage machines with a 24 to 1 compression ratio have been designed. The patented design of the rotors is already proved in a variety of aircraft installations.

For more details on these efficient compressors write to:
STRATOS DIVISION, Bay Shore, L. I., N. Y.

**STRATOS**

A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION

Main Plant: Bay Shore, L. I., N.Y.
West Coast Office: 1355 Westwood Blvd., Los Angeles, Calif.
Western Branch: 1800 Rosecrans Ave., Manhattan Beach, Calif.

WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS

## FOR THE GIANT JETS...

### scores of precision components

Through many years Kelsey-Hayes has worked closely with major aircraft engine builders. Today, with the addition of new plants, expanded research and engineering staffs, and augmented production facilities, assignments from the aviation industry are increasing rapidly.

Products include accessory gear assemblies, actuators, transmissions, power recovery units, radar tracking and scanning equipment, computers and controls. And for jets: compressor rotors, turbine sections, blades, buckets, vanes.

Kelsey-Hayes has the experience and facilities for research, design, prototype development and production.

# KELSEY-HAYES

**Kelsey-Hayes Wheel Co., Detroit 32, Mich. • Major Supplier to the Automotive, Aviation and Agricultural Industries**

*14 PLANTS / Detroit and Jackson, Michigan; McKeesport, Pa.; Los Angeles, Calif.; Windor, Ontario, Canada • Davenport, Iowa (French & Hecht Farm Implement and Wheel Division) • Springfield, Ohio (SPECO Aviation, Electronics and Machine Tool Division) Utica, New York—4 plants—(Utica Drop Forge and Tool Corporation, a subsidiary)*

## Egyptians "Dummy" MiG-15

**Egyptians, in caption on radiophoto from Cairo, called this a dummy MiG-15 jet fighter used to decoy British and French bombers from genuine targets at Almaza Airport near the Suez canal. However, close inspection of the photograph indicated the dummy was equipped with hinges on the control surfaces, plug for the tailpipe, and in general showed unique refinement for a dummy. Egyptians claimed dummy aircraft bore brunt of pre-invasion raids.**

all four engine cowl flaps were full open. Flight testing has shown that buffeting occurs on the Stratocruiser when cowl flaps are full open and wing flaps retracted.

When the buffeting developed, the crew failed to determine that it was caused by full-open cowl flaps, which should have been closed before takeoff. The captain thought his wing flaps might have retracted unevenly, creating a split-flap condition.

The CAB said it recognized that a number of events occurred in an extremely short space of time, and that the urgency of the situation required a rapid decision. The Board said the captain acted promptly, but that his incorrect analysis of the control difficulty "led to an unfortunate decision."

The CAB concluded that the flight information manual on conditions created by excessive cowl flap openings was "sufficiently stressed to allow the captain, and indeed the entire crew, to evaluate the difficulty properly within the time available."

## Orders Listed for Convair 880s, DC-8s

**Washington**—California Eastern Aviation has ordered four Convair 880 turbojet transports for use on its long-range overseas routes, and the French airline Union Aero Maritime de Transport has ordered three DC-8s.

Orders for the four Convair transports also will help the contract airline's case when it goes before the Civil Aeronautics Board to ask for a Texas-California route in the impending Dallas-to-the-West Route Case.

Delivery of the DC-8s to UAT will begin in 1960, but the government still must approve purchase of the two on option. DC-8 was selected over Boeing jet transport and Comet IV. Choice of Pratt & Whitney J75 or Rolls-Royce Conway will be made within a month.

## News Digest

**Modified "flying bedstead,"** powered by two Rolls-Royce Nene jet engines, has made several short test flights. First vehicle was flown in August 1954.

**First Lockheed F-104A** Starfighter was lost earlier this month when it experienced a flameout and crashed onto Rogers Dry Lake, two miles south of Edwards AFB, Calif. The pilot, Capt. Harry A. Brown, who was killed in the accident, called the Edwards tower shortly before the crash to report the flameout and said he hoped to glide the plane onto an Edwards runway.

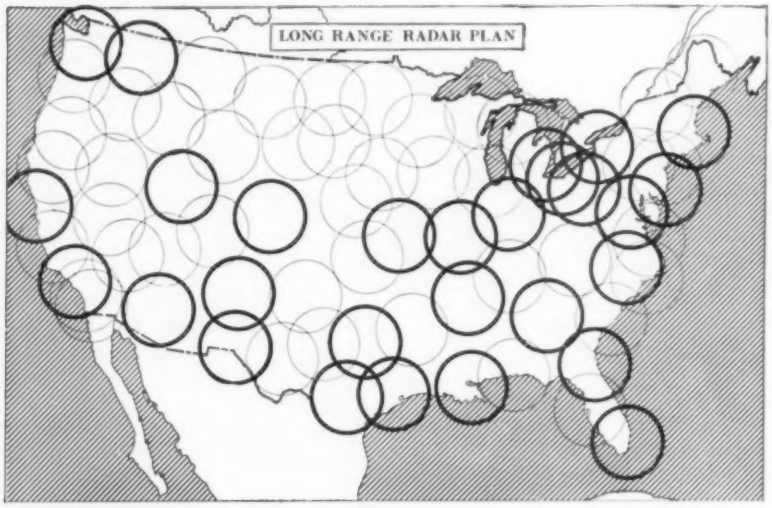
**Research and development** center costing $15 million will be built by Avco Manufacturing Corp. on a 100-acre site in Wilmington, Mass. One of the prime projects at the center will be ICBM nose cone development. Avco will move shock tube from Everett, Mass., to the center, which will be in operation by mid-1958.

**Preliminary investigation** of the crash of a Hurel-Dubois H. D. 321 in Rio de Janeiro Bay Oct. 30, puts the cause as poor visibility. Displayed in a French manufacturers sales show (AW Nov. 12, p. 45), the H. D. 321 crashed when one of its wings touched the water. It sank in water 16 ft. deep.

**Vice Adm. Ralph A. Ofstie,** former deputy chief of naval operations for air, died at Bethesda Naval Hospital on Nov. 18. Adm. Ofstie began his career as a naval aviator in 1922 as a test pilot with the Plans Division of the Bureau of Aeronautics. He established three world speed records for seaplanes and subsequently served as White House aide, commander of the Flight Test Division at Anacostia Naval Air Base and as naval attache in Tokyo and London. During World War II, he commanded the carrier USS Enterprise and participated in aerial attacks on Rabaul, the invasion of Gilbert Islands and the Marshall Islands and the Battle of the Philippine Sea. After two years' service as Deputy Chief of Naval Operations, he commanded the Sixth Fleet from March, 1955, until his illness. Adm. Ofstie is survived by his wife, Joy Bright Hancock Ofstie, former WAVE director.

**First flight** has been made by Air-Fogua's CM171 experimental plane for Turbomeca's new 2,500 lb. thrust Gabizo engine. The Makalu is slightly modified version of Fouga's Magister trainer and has demonstrated its climbing performance by reaching 40,000 ft. 9 min. 20 sec. from takeoff.

# Radar Net Will Be Ready for Jet Control




**LONG-RANGE** radars ordered by CAA will be installed at major airports shown (heavy circles) within two years. These will be supplemented by military radars not shown. Forty-foot antenna (below) will be used in new L-band radars to be produced by Raytheon.

By Philip J. Klass

**New York**—Twenty-three long-range Raytheon radars ordered by the Civil Aeronautics Administration (AW Nov. 19, p. 25) are expected to be in operation within two years, in time to meet the increased traffic control problems posed by new jet transports.

The $9 million order, called "one of the most significant steps in the CAA's history" by James Pyle, acting CAA administrator, is the largest single avionic procurement ever made by that agency. Pyle also revealed that the CAA's $246 million three-year facilities expansion program, which was originally telescoped from a five-year plan, may get additional funds.

The 23 Raytheon sets, together with five air defense radars, will form the nucleus of an eventual network of 70 civil and military stations intended to give traffic controllers complete radar surveillance of the entire country from 15,000 to 70,000 ft. altitude plus airways coverage below 15,000 ft.

## Peak Power

The CAA radars are similar to those ordered from Raytheon last spring by Canada (AW April 23, p. 69). The sets will have a peak power of 500 kw., but in about three years Raytheon says it will be possible to boost peak power to four megawatts merely by adding a new type of radar amplifier, called the Amplitron. The sets operate in L-band.

Present power will give the radars an effective range of 150 statute miles against B-47 size jets, 200 mi. against DC-6 size propeller-driven aircraft, Raytheon says. The addition of the Amplitron should increase the DC-6 detection range from 200 to 350 mi., with a proportional increase for jets, according to Raytheon.

CAA plans to install the new radars at 23 major airport terminals. This will extend the terminal area radar control from the present 50 mi. maximum out to 150-200 mi. The Chicago, Boston, Norfolk triangle will have almost continuous coverage of major airways.

## Radar Locations

The new radars will be installed at the following locations:

Atlanta; Atlantic City, N. J.; Albuquerque; Benson, N. C.; Boston; Buffalo; Cleveland; Denver; Detroit; El Paso; Ft. Worth/Dallas; Houston; Indianapolis; Jacksonville, Fla.; Kansas City; Los Angeles; Memphis; Miami;

New Orleans; Oakland, Calif.; Phoenix; Pittsburgh; Salt Lake City; San Antonio; Seattle; Spokane; St. Louis; and Washington D. C.

Major terminals not included on this list, such as New York, Chicago and Norfolk, will utilize military or air defense radars already installed.

The new CAA radars will be outfitted with circular polarization which greatly reduces the signal return from precipitation (clutter). A Raytheon spokesman estimates that circular polarization provides a 20:1 improvement in the ability to detect an airplane in a thunderstorm.

### Radar Features

The sets will have one or two master 16-in. scope consoles with five remote indicators which can be operated at distances up to two miles away. A new improved MTI (moving target indicator) using a three-pulse system is provided to enable the operator to display only moving targets and eliminate clutter from ground objects.

The traffic controller will also be able to superimpose on the radar scope an electronically generated map of the territory under surveillance to show terrain obstacles and to pin point the geographical position of the various aircraft.

The radar stations will be built with complete duplicate equipment for standby operation, except for the 40-ft. diameter antenna.

Automatic monitoring equipment will be provided to spot deterioration in radar performance and to alert the operator automatically.

### Only the Beginning

Pyle cautioned that although the CAA expects to achieve major improvements in traffic flow with its new radars, this is not the complete answer to present problems. "We have to improve our communications facilities, install more navigation aids and recruit and train additional personnel," Pyle said.

In answer to a question about possible pay-scale downgrading of traffic controllers in line with a recent civil Service Commission study (AW Oct. 1, p. 41), Pyle said that there would be a two-year moratorium to permit the transfer of affected controllers to higher density locations where their present skills and ratings could be used without salary drop.

Pyle praised the military, and particularly the Air Force, for its cooperation in working with the CAA to develop ways to permit the use of air defense radar information for civil air traffic control.

Pyle said that the CAA will make data from its civil radars available to the military if so desired.

# International Travel Dominated By Airline Industry in Fiscal '56

By Craig Lewis

**Washington**—Airlines industry dominated the international scene during Fiscal 1956 during which travel between the U.S. and other nations set new records.

A report from the U.S. Immigration and Naturalization Service for the year ending on June 30, shows that 2,071,130 passengers arrived at U.S. ports by sea and air, and 1,813,498 passengers departed. Arrivals increased 13%, and departures gained 15% over the previous year's traffic.

During the 1956 fiscal year, 68% of all passenger traffic between the U.S and other nations traveled by air. Air traffic increased 141% between 1950 and 1956, while sea travel increased only 16%. Air travel gained 20% between 1955 and 1956, while sea travel rose only 2%.

These travel statistics cover passenger traffic between U.S. ports and foreign countries but do not include travel across U.S. border to Canada and Mexico, travel by seamen or military personnel or travel between the U.S. and its possessions. Cruise travelers also are excluded.

On the heavily traveled routes to Europe, more passengers traveled by air than by sea for the first time. While sea traffic has leveled off in the past three years, air travel has continued to grow. In 1956, 404,701 passengers flew from the U.S. to Europe, and 380,087 went by sea.

Most alien travelers continue to prefer sea transportation, but most U.S. citizens prefer to fly.

In Fiscal 1956, travel from the U.S. increased to all major areas of the world but Africa. The African decline was due to a decrease in travel to French Morocco.

Last June, a peak month for North Atlantic travel, 123,572 people left the U.S. for Europe, and over 100,000 of them were U.S. citizens, many of them on vacation. Nearly two thirds of the European traffic goes to the United Kingdom, France and Germany.

German traffic does not have the marked seasonal pattern of travel to other countries, much of it consisting of families of military and civilian missions.

Travel to Asia increased 64% between 1952 and 1956, and was up 24% in the last year alone. Increases were noted in travel to Japan, which attracts 60% of all Asian travel; to Hong Kong, Israel, the Philippines and the Ryukyu Islands, including Okinawa. Within the past two years, air travel to Asia has increased. Last year more than half of all passengers for Asia went by air.

Increases in travel to Peru and Venezuela accounted for most of the 10% rise in travel to South America last year. U.S. citizens accounted for 44% of the traffic to South America, and nearly half of them went to Venezuela. The airlines carry almost 80% of all passengers going from the U.S. to South America.

While U.S. airlines continue to carry more passengers, the foreign flag airlines' share of the market also gained last year. Travel on U.S. carriers increased 18%, travel on foreign airlines increased 26%.

On European routes, American flag airlines carried 58% of the total air traffic; 86% of the passengers flying to Asia traveled on U.S. carriers. Japanese and Israeli airlines carried most of the remaining Asian traffic.

Virtually all air traffic to Africa flew on U.S. carriers, and three-fourths of the travel to the Australian-New Zealand area was on an American carrier. Canadian and Australian airlines carried the remainder bound for the area.

In the North American area, 70% of the air passengers chose American carriers. Nine out of 10 travelers flying to Bermuda went on U.S. carriers, while the other 10% flew on British aircraft. U.S. airlines carried 75% of the air traffic to the British West Indies and 66% of the traffic to Cuba.

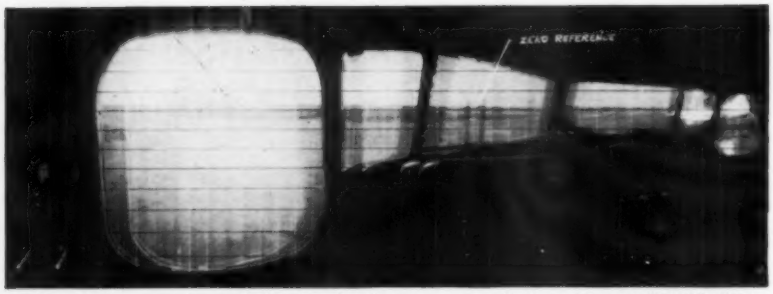
On routes to South America, the American airlines flew 62% of the passengers. Most of the balance was carried by Colombian and Venezuelan airlines with 27% of the total.

While the U.S. flag airlines continued to dominate air travel, sea travel on ships of U.S. registry declined 6%. At the same time, foreign flag ships carried 7% more passengers last year than they did the year before. Foreign flag ships carry about two-thirds of the passenger traffic to and from the U.S.

## Fuel Available Abroad

**Paris—American and foreign airlines operating out of Paris report no fuel shortage problems and that no plans are underway to curtail present schedules.**

**Airlines explain that the high octane gas they use is unaffected by the present Middle East crisis. Most aviation gasoline used here is of Venezuelan or American origin and is largely refined in the U. S. before shipment here.**

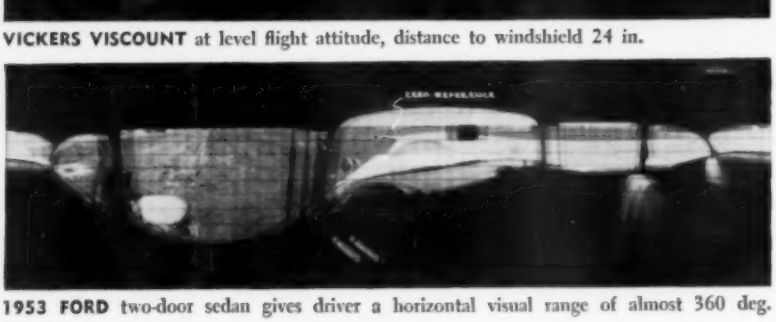


**DC-7** at ½ deg. nose down flight attitude, distance from pilot's seat to windshield, 28 in.

**MARTIN 4-0-4** at level flight attitude, distance from pilot's seat to windshield, 27 in.

**SUPER G** Constellation at ½ deg. nose up flight attitude, distance to windshield 21 in.

**VICKERS VISCOUNT** at level flight attitude, distance to windshield 24 in.



**1953 FORD** two-door sedan gives driver a horizontal visual range of almost 360 deg.

# Bad Visibility Blamed In Mid-Air Collisions

By L. L. Doty

**Washington**—Aircraft Owners an Pilots Assn. has blamed poor cockp visibility of transport aircraft for th majority of mid-air collisions and nea misses involving airliners. The associa tion also charged that the "carelessness of airline pilots is a major contribut to the present collision hazard.

According to a Civil Aeronautic Board study of 127 mid-air collisions r ported between 1948 and 1955, 11 the accidents were between air carrie and private aircraft. Military and pr vate planes were involved in 16 acc dents, while 96 of the collisions i volved private aircraft only. In th report, the CAB concluded that "pa experience has shown that general (pr vate) aircraft have been involved in th highest number of mid-air collisions b far (AW July 30, p. 32)." There are a estimated 60,000 private aircraft in th U. S., and 1,600 airliners. The militar has a total of approximately 42,000 ai craft on hand in the U. S. and oversea

In support of its charges against th airlines, AOPA distributed composit photographs comparing cockpit visibi ity of transport aircraft with the visu range of a 1953 Ford two-door sedar The photographs were taken by th Civil Aeronautics Administration' Technical Development Center in In dianapolis.

AOPA contended that the airlin pilot has "from 170 to 200 degrees horizontal visibility as compared wit the "almost 360 degrees" of horizont range available to the automobile drive "It is the deficiency of vertical visibi ity," it added, "where the airline pilc suffers most."

Photographs show, AOPA said, tha adequate vertical visibility is availabl only from the nearest left-hand window and "that the pilot in the left-hand sea cannot see an overtaking airplane on hi right until it is flying abreast of hi aircraft at approximately the same alt tude."

According to latest collision test r sults issued by the Technical Develop ment Center, pilots of single engin civil aircraft have an azimuth visibilit advantage over pilots of multi-engin private and airline aircraft (AW Nov. p. 38). Azimuth visibility on militar jet aircraft is superior to that of any ai craft studied by the center.

However, the tests disclosed tha an average multi-engine aircraft has slight visibility advantage over othe types in vertical range below the line azimuth. Vertical cut-off angle of pilc vision averages eight degrees on militar jets with single and tandem seating; si

degrees on single engine private aircraft and 10 degrees on multi-engine planes.

Above the center line, jets again hold an edge over other types of aircraft. Cut-off angle of vision above azimuth averages 40 degrees on military jets; 38 degrees on single engine aircraft and 20 degrees on multi-engine private and transport aircraft.

AOPA said most collisions occur while aircraft are under visual flight rules and added:

"AOPA has long contended that the absence of adequate visibility, in all directions, and the failure of pilots to watch where they are going, are major factors in causing mid-air collisions," the group stated.

The CAB study bore out AOPA's statement that most collisions occur when "visibility is good." Clear weather, it said, prevailed in 117 of the 127 accidents.

AOPA said that it had formally petitioned the CAB last March to establish cockpit visibility standards for all civil aircraft.

It added that no formal action on the petition has been announced although it was considered at CAB's annual airworthiness review last September. The recommendation met opposition from manufacturers, AOPA said.

## Air Express Handles Big Magazine Issue

**New York**—Air Express earned over $51,000 in revenue from its biggest single shipment, 429,031 lb. of Newsweek magazines handled in a special operation following the elections.

Using 21 chartered aircraft and space on regular flights of most scheduled airlines, Air Express moved a million copies of the magazine from the main Dayton, Ohio, printing plant, another quarter million from a Los Angeles printer.

Deliveries were made to 18 regional post offices for mailing and to 525 cities in the U. S. and Canada for newsstand distribution.

Air Express utilized 609 extra vehicles and 36 extra employes for the operation.

The magazine's normal Sunday printing schedule was moved back until Tuesday night to include election results and analyses. Air Express coordinated the movement from a project headquarters in Dayton. First shipment went out at 12:49 a.m. Nov. 7 by Trans World Airlines to Columbus. American Airlines, Flying Tiger, Riddle, Slick, United and Lake Central provided the charter flights.

Air Express handled a similar project for Newsweek in 1940, moving 35,000 lb. of magazines containing Roosevelt-Willkie election returns.

# Addition of East, Midwest Routes Doubles Riddle's Cargo Business

By Glenn Garrison

**Miami**—Riddle Airlines has doubled its scheduled air cargo business since starting service last January to most of the 13 midwestern and eastern cities added to its route pattern by the Civil Aeronautics Board last year.

Expanding its ground facilities and aircraft fleet, the airline expects to do even better in 1957 and to increase its carriage of mail and express.

Riddle has lifted more than 33 million pounds of commercial cargo this year so far, expects the totals to exceed 40 million. Last year, operating only between New York, Miami and Puerto Rico except for seasonal services to a few other Florida points, Riddle carried 20 million pounds of cargo.

Following the CAB decision last November in the North-South Airfreight Renewal Case awarding Riddle a five-year certificate and the new routes, the cargo carrier moved fast to get into the additional cities by the Jan. 20, 1956, effective date. Now cities served regularly are Jacksonville, Philadelphia and Boston in the East; Atlanta, Cincinnati, Cleveland, Detroit and Chicago on the carrier's route to the Midwest. Other cities, including Richmond, Louisville, Washington, Baltimore and Columbus, are served on a demand basis and will ultimately be scheduled stops.

Riddle needed equipment when its new services opened, according to Charles L. Hood, vice president-sales. Its fleet as of October 1955 totaled 22 C-46s and four DC-4s, with a number of the Curtiss aircraft tied up in military contract work.

Some C-46s were leased to fill the immediate gap until additional Riddle planes—10 C-46s—were delivered this year. The airline also leased a DC-6A from the Air Force and put it into New York-Miami service on Nov. 1.

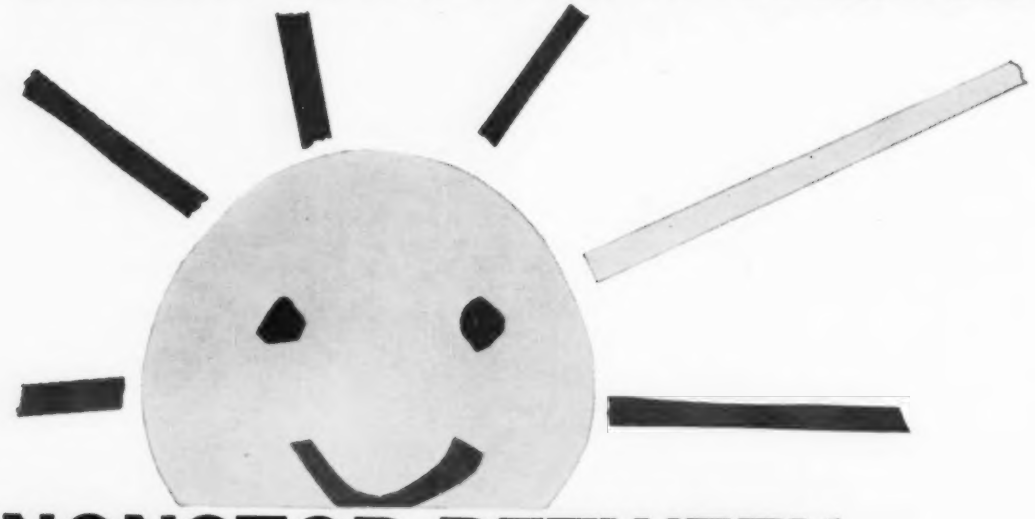
Another DC-6A is being purchased from Douglas, with delivery expected in October 1957. Three more have been optioned and are expected during the summer and fall of 1958. Discussions also have been held with Lockheed, Hood says, regarding possible purchase of Constellation 1049H equipment.

The C-46, however, will be in use as a feeder aircraft for a long time, according to John Paul Riddle, president of the airline. The carrier's own C-46 equipment is undergoing a T-category modification program which is expected to increase the planes' speed from 195

## DC-7C Makes Record Flight

**Scandinavian Airlines System DC-7C taxis to ramp at Bromma Airport, Stockholm, after flying 6,005 mi. non-stop from Long Beach, Calif. carrying only the 7,824 gal. of fuel in its standard tanks. Great circle route over Labrador, Greenland and Iceland, flown at economy cruise speed of about 270 mph. and altitudes of 13,000-17,000 ft., required 21 hr., 44 min. Conducted under Federation Aeronautique Internationale supervision, flight exceeded record of 5,700 mi. set by a DC-6B on a Los Angeles-Paris flight in 1953.**

# MORNING 'TIL NIGHT
# EVERY HOUR ON THE HOUR



# NONSTOP BETWEEN

# NEW YORK-CHICAGO

From 8 am to 9 pm New York to Chicago and 7 am to 11 pm Chicago to New York

**AMERICAN AIRLINES**

*America's Leading Airline*

to 230 mph. and to up the gross-weight from 48,000 to 50,000 lb. Riddle figures the present direct operating cost of his C-46 equipment at 10.5 cents per ton-mile with full payload, and hopes the modified planes will cost 15% less to operate.

Riddle foresees a tremendous potential in the new markets his airline is serving, and expects another 60% boost in traffic next year. Common carriage business will provide the greatest opportunity for the airline, its president feels, but military work—which this year about equals the commercial business in terms of hours flown—will continue to be sought. The carrier handles Dew Line and Logair's assignments for the military and started a new $10 million Logair contract on July 1.

### Airfreight Prospects

One reason prospects for air cargo development are bright, according to Riddle, is the cumulative effect of airfreight promotion by all carriers. Growing availability of cargo facilities is seen by Riddle as another favorable factor, although he believes many airport managements should give more attention to their cargo handling expansion.

Load factors dropped with the inauguration of the new routes, Riddle reports, but are climbing back as new traffic develops. Last year, over the limited routes with their long-haul character, the airline's average load factor topped 87%. This year, with new shorter-haul segments on the expanded route pattern, load factors dropped to 60%. By October they had passed 70% again.

Traffic from Riddle's five midwestern route stations has increased steadily, according to the airline, with almost six million pounds originating at these points, January through September.

Chicago service provides Riddle with important interline business through the east-west carriers. An example is shipment of prepackaged assemblies from the West Coast, connecting with Riddle and destined for Lockheed Aircraft's C-130 plant near Atlanta. From Atlanta to the south, Riddle is handling, among other things, a volume of mail orders teletyped from Florida to Sears-Roebuck.

### Product Variety

Typical shippers in the new territory are automobile, chemical, wearing apparel, pharmaceutical and electronic concerns. Extension of Riddle's routes ties in Puerto Rico with markets in the Midwest, and a variety of products are moving over these segments.

During the two months between the CAB decision and the Jan. 20 effective date of the new authority, Riddle people had their hands full finding ground facilities and personnel for the new stations.

Hood and other officials went on the road to set up the stations, while Riddle concentrated his efforts at Miami in the search for aircraft.

At some airports, facilities were not immediately available and the Riddle officials worked out temporary arrangements with other organizations. They arranged with Slick at Detroit, for example, to handle Riddle's operation there for a short time. Riddle now has its own facility and people at Detroit. At Chicago, on the other hand, Riddle is still using Slick facilities at O'Hare Airport, while a Riddle station manager and agents are handling the operation.

Washington National Airport, where no facilities could be found, was served by Riddle through an arrangement with California Eastern, according to Hood. Scheduled Washington service has since been discontinued by Riddle because the southbound potential was found to be poor, but either Washington or Baltimore will be served when the schedule pattern evens out.

In working out schedules, Hood says, "care must be used to build a balance of traffic between stations or you will shorthaul yourself to death."

Another concern of the management team setting up the new stations was leasing trucking facilities for ground pickup and delivery. This problem was simplified in September when Riddle became part of Air Cargo, Inc.

In May, the airline was authorized to carry mail to all points on its system and by the end of September had lifted 44,628 lb. Air mail and parcel post business is expected to increase greatly, according to Riddle.

The airline has filed a petition for reconsideration of the New York-Florida case, in which Riddle sought to carry passengers, and also has applied for authority to haul passengers between Puerto Rico and Miami.

But air cargo business will continue to be the carrier's main concern in the foreseeable future, according to its president.

## Transport Testbeds

**Three transport aircraft with piston engines replaced by Napier Eland turboprop engines are photographed together as part of Napier's sales push for the engine. Convair 340 (foreground) was demonstrated at IATA general meeting at Edinburgh (AW Sept. 24, p. 47). Elizabethan (Airspeed Ambassador) is in the middle and Vickers Varsity in background. Retention of piston engine mounting bulkhead for ease of conversion meant using nacelle larger than necessary for Eland 36-in. frontal diameter.**

## SHORTLINES

▶ **Aer Lingus** reports revenues of $5,298,720 and a profit of $963,000 for the first half of its current fiscal year. The Irish airline carried 314,056 passengers during the six-month period; its revenue load factor was 76%.

▶ **Braniff Airways** has declared two 15 cent dividends for its 2,948,119 shares of common stock. First dividend is payable Nov. 28 to shareholders of record as of Nov. 23; the second is payable on Dec. 28 to shareholders of record as of Dec. 17.

▶ **British Overseas Airways Corp.** will cut fares on its New York-Nassau route on Dec. 16. New round trip fares will be $137 tourist and $181.80 first-class. Along with the removal of federal taxes on these fares, the reductions save

# THE DE HAVILLAND COMET 4

# JET AIRLINERS

*ordered by*

# CAPITAL AIRLINES

*are powered by*

# ROLLS-ROYCE

# AVON

## GAS TURBINES

★

ROLLS-ROYCE AERO ENGINES LEAD THE WORLD

$47.50 tourist and $21.70 first-class. BOAC will operate nine New York-Nassau flights a week this winter, all with Boeing Stratocruisers.

▶ **Canadian Pacific Airlines** last week increased its Toronto-Mexico City service from two to three flights a week and introduced the family plan on the route. The airline also increased its Mexico City-Buenos Aires service to two flights a week in order to improve connections between the two services.

▶ **Capital Airlines** began Viscount service from New York International Airport this month with five daily flights to Cleveland, Detroit, Chicago and Minneapolis-St. Paul.

▶ **Delta Air Lines** has granted pay increases totaling $1 million to non-supervisory, administrative and non-contract personnel. These categories cover 80% of Delta's 5,483 employes.

▶ **Italy's Ministry of Defense** has announced that a regular helicopter service will be operated between Rome and Naples. A new company reportedly will be established to build helicopters and operate them. It will be a joint venture of Alitalia, Linee Aeree Italiane and Fiat.

▶ **Lake Central Airlines** carried 14,744 passengers in October, a 23.4% gain over the previous October, and operated with a load factor of 49.83% during the month.

▶ **Lockheed Aircraft Service-Intl.** delivered 746 aircraft in the third quarter, bringing the total for the first nine months of this year to 2,094 aircraft.

▶ **Pan American World Airways** pulled a switch and published a guide to travel in the U. S. "New Horizons, U. S. A." was compiled with the help of American Airlines and numerous domestic travel organizations. The book is designed to promote travel to the U. S. in overseas markets and will be printed in French, German, Italian and Spanish, as well as English.

▶ **Qantas Empire Airways** has ordered weather radar for its Super Constellations from the Radio Corp. of America.

▶ **South African Airways'** Constellation and DC-7 fleets will be equipped with Bendix X-Band weather radar.

▶ **Swissair** is using three DC-6Bs to fly the United Nations International Police Force from the Naples staging area to Egypt. While the troop movement lasts, Swissair will fly six flights a day, carrying 400 men with their equipment.

# AIRLINE OBSERVER

▶ Watch for a decision on a downtown airlines terminal building in Chicago within the next two months. Chicago's Downtown Terminal Committee is being prodded by a number of civic associations for a decision on one of the 22 sites the committee has under consideration. North-Western Railway Station is receiving strong backing as an airline terminal, although some officials object to its inconvenient location outside the Loop. Observers say the railroad has offered to operate commuter train service every thirty minutes between downtown Chicago and O'Hare Field if the station is selected by the airlines. Other ready-made terminals being studied are Dearborn Railroad Station and the Greyhound Bus Terminal.

▶ **Thomas Basnight, former assistant to John Groves of the Air Transport Assn. Air Traffic Control Department in New York, will join the Air Line Pilot's Assn. on Dec. 1 as a Washington representative of the Engineering and Air Safety Department and assistant to Larry Cates.**

▶ Lockheed's second 1649A, first of Trans World Airlines' order for 25 of the new Super Constellations, is off the production line and is scheduled for its first flight in January. Flight tests will serve to certify the plane's systems.

▶ **Heart patients can travel by air without undue danger, although oxygen administration may be necessary in pressurized transport aircraft, according to Dr. Lawrence E. Lamb, director of the cardiology department of the USAF School of Aviation Medicine at Randolph Field, Tex. Dr. Lamb warned that cardiac patients have a lower altitude threshhold than normal persons and said, beyond 18,000 ft. altitude, heart collapse may occur. However, in cabins pressurized to 8,000 ft., administration of oxygen will reproduce a sea level environment enabling cardiac patients to travel in comfort.**

▶ U. S. delegates to the International Labor Office meeting on civil aviation beginning today in Geneva and continuing to Dec. 8 are Robert Wharton, assistant vice president of personnel, Delta Air Lines; Joseph O'Brien, executive director, Airlines Personnel Relations Conference, and Clarence Sayen, president of the Air Line Pilots Assn. Items on the agenda include flight personnel work hours, income security of flight personnel after retirement or grounding and a review of employment conditions in civil aviation.

▶ **Hawaii Aeronautics Commission may delay until next year the naming of a successor to Randolph Lee as its director. Lee resigned earlier this month. The commission also plans to ask the 1957 legislature to increase the director's salary. Present level is $11,000.**

▶ Delta Air Lines translated a number of its booklets, including a history of the airline and speeches by President C. E. Woolman, into French to accommodate a group of French Diet members booked on a recent flight from Washington to New Orleans.

▶ **Mutual of Omaha will offer travel insurance to international air travelers at a standard premium rate of $5 for $62,500 coverage regardless of the part of the world visited. Current rates vary between $10 and $20 for the same amount, depending upon the traveler's destination. Sales and service of new travel policies will be administered by Teletrip Co., a wholly owned subsidiary of Mutual of Omaha.**

▶ Total miles flown by political campaigners in the 1956 election were 25% above the 1952 campaign figure. Republicans and Democrats estimate that party workers covered a total of more than 220,000 miles of air travel up to election time, and that 100,000 scheduled airline reservations were used for campaign purposes. President Eisenhower, however, flew less than half the total miles he covered in 1952.

▶ **Cargo handling methods at all Slick Airways terminals are undergoing study and analysis by Drake, Startzman, Sheahan and Barclay, distribution and materials handling consultants of New York. The study is aimed toward streamlining all aspects of cargo handling to reduce costs and promote greater cargo capacity.**

# Cessna T-37 designed for Jet Training

To meet jet age demands, the U. S. Air Force requires a jet trainer that makes it easy for cadet-pilots to master first-line combat airplanes.

The Cessna-developed T-37 introduces the cadet to all combat jet airplane characteristics while training on this safe, easy-to-fly jet trainer.

It is designed to provide the Air Force with a jet trainer that can be operated at substantial savings and cover the most important and longest phase of the cadet-pilot's jet training.

It is a privilege for us here at Cessna to team with the Air Force in its forward-thinking plans for the jet age. CESSNA AIRCRAFT COMPANY, Wichita, Kans.

Cessna

*Cessna T-37 . . . safe, slow-speed landings for Air Force cadet-pilots.*

**Be an Aviation Cadet. Inquire today about the future your Air Force offers from your Air Force Recruiting Office.**

# Airline Traffic — September 1956

| | Revenue Passengers | Revenue Passenger Miles (000) | Load Factor | U. S. Mail | Express | Freight | Total Revenue Ton-Miles | Per Cent Revenue to Available Ton-Miles |
|---|---|---|---|---|---|---|---|---|
| **DOMESTIC TRUNK** | | | | | | | | |
| American | 687,030 | 439,189 | 70.44 | 1,517,116 | 982,150 | 6,749,807 | 51,497,903 | 62.07 |
| Braniff | 151,899 | 61,907 | 63.89 | 215,340 | 136,955 | 363,394 | 6,653,886 | 56.63 |
| Capital | 284,967 | 97,273 | 58.52 | 284,717 | 219,848 | 319,631 | 10,136,871 | 44.87 |
| Continental | 63,196 | 23,313 | 58.29 | 67,965 | 26,488 | 99,622 | 2,433,399 | 49.31 |
| Delta | 195,361 | 89,364 | 55.25 | 290,184 | 325,859 | 651,068 | 9,852,917 | 52.01 |
| Eastern | 595,243 | 272,066 | 56.06 | 917,232 | 502,679 | 1,284,329 | 30,320,847 | 44.78 |
| National | 91,335 | 56,909 | 58.36 | 220,591 | 49,108 | 351,781 | 6,429,997 | 57.76 |
| Northeast | 59,225 | 11,860 | 57.71 | 9,216 | 20,172 | 30,740 | 1,135,874 | 54.16 |
| Northwest | 124,491 | 86,148 | 68.24 | 370,315 | 262,917 | 735,573 | 9,812,602 | 59.06 |
| Trans World | 382,841 | 311,555 | 69.66 | 927,127 | 897,208 | 2,176,530 | 33,857,680 | 63.21 |
| United | 589,469 | 423,475 | 71.75 | 2,110,916 | 1,195,359 | 5,008,631 | 49,049,318 | 62.65 |
| Western | 103,616 | 52,634 | 63.57 | 211,389 | 83,868 | 170,993 | 5,499,635 | 56.05 |
| **INTERNATIONAL** | | | | | | | | |
| American | 12,926 | 9,079 | 65.07 | 12,338 | 602 | 305,070 | 1,254,750 | 65.58 |
| Braniff | 2,640 | 6,092 | 53.14 | 18,877 | ..... | 56,520 | 773,451 | 56.49 |
| Caribbean Atlantic | 11,433 | 782 | 54.08 | 1,032 | ..... | 8,507 | 79,258 | 52.63 |
| Delta | 4,649 | 5,716 | 63.17 | 6,410 | ..... | 39,252 | 643,780 | 50.99 |
| Eastern | 22,181 | 29,551 | 64.30 | 60,609 | ..... | 80,356 | 3,279,055 | 56.39 |
| National | 6,850 | 3,689 | 38.39 | 7,602 | 3,838 | 33,741 | 420,750 | 39.97 |
| Northwest | 10,839 | 24,515 | 69.97 | 822,502 | 18,763 | 823,088 | 4,353,124 | 76.22 |
| Pan American | | | | | | | | |
| Alaska | 9,486 | 10,429 | 71.56 | 46,700 | ..... | 404,211 | 1,531,532 | 62.26 |
| Atlantic | 107,092 | 143,247 | 67.12 | 944,071 | ..... | 2,229,962 | 18,051,193 | 63.91 |
| Pacific | 26,731 | 80,001 | 75.58 | 942,089 | ..... | 1,284,012 | 10,493,380 | 70.91 |
| Latin America | 94,445 | 96,730 | 66.12 | 319,334 | ..... | 3,242,588 | 12,772,590 | 63.19 |
| Panagra | 12,284 | 14,446 | 61.55 | 52,919 | ..... | 280,108 | 1,888,849 | 59.66 |
| Trans World | 31,154 | 83,551 | 70.75 | 687,016 | ..... | 831,933 | 10,228,279 | 73.31 |
| United | 12,065 | 29,985 | 84.40 | 91,945 | ..... | 59,158 | 3,211,918 | 77.34 |
| **LOCAL SERVICE** | | | | | | | | |
| Allegheny | 39,274 | 6,532 | 46.36 | 6,712 | 20,529 | 9,800 | 660,550 | 47.67 |
| Bonanza | 10,652 | 2,349 | 44.31 | 3,399 | 2,791 | 8,005 | 238,051 | 43.09 |
| Central | 9,200 | 1,874 | 37.94 | 3,587 | 3,038 | 5,932 | 191,819 | 33.97 |
| Frontier | 18,427 | 4,770 | 51.42 | 15,174 | 8,537 | 56,902 | 630,227 | 63.17 |
| Lake Central | 13,003 | 2,077 | 48.92 | 2,424 | 16,118 | ..... | 206,638 | 42.68 |
| Mohawk | 33,072 | 5,795 | 50.04 | 5,457 | 10,162 | 12,599 | 588,928 | 50.16 |
| North Central | 54,483 | 8,854 | 56.07 | 17,828 | 35,633 | ..... | 899,022 | 50.33 |
| Ozark | 30,471 | 4,701 | 41.04 | 10,154 | 20,907 | 13,006 | 484,032 | 42.85 |
| Piedmont | 35,982 | 6,754 | 54.73 | 13,080 | 16,453 | 13,471 | 690,154 | 54.89 |
| Southern | 15,912 | 2,797 | 43.99 | 7,820 | 17,403 | ..... | 293,103 | 42.55 |
| Southwest | 29,533 | 6,080 | 56.39 | 7,567 | 4,616 | 7,860 | 598,787 | 54.26 |
| Trans Texas | 20,109 | 4,573 | 41.05 | 11,924 | 8,948 | 23,634 | 480,478 | 38.08 |
| West Coast | 20,037 | 3,576 | 48.08 | 3,058 | 2,234 | 5,502 | 334,266 | 47.88 |
| **HAWAIIAN** | | | | | | | | |
| Hawaiian | 35,281 | 4,807 | 56.35 | 3,752 | ..... | 106,600 | 533,216 | 55.30 |
| Trans Pacific | 19,917 | 2,487 | 57.21 | 701 | ..... | 13,002 | 205,446 | 55.49 |
| **CARGO LINES** | | | | | | | | |
| Aerovias Sud Americana | ..... | ..... | ..... | ..... | ..... | 556,985 | 556,985 | 69.01 |
| Flying Tiger | 6,155 | 23,237 | 99.53 | 31,188 | 48,351 | 6,369,005 | 8,772,296 | 83.35 |
| Slick | 5,414 | 25,514 | 93.89 | 65,838 | 74,375 | 5,001,756 | 7,693,408 | 79.87 |
| Riddle* | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Seaboard & Western | 2,256 | 7,038 | 100.00 | ..... | ..... | 2,221,567 | 2,925,434 | 85.24 |
| **HELICOPTER** | | | | | | | | |
| New York Airways | 3,894 | 73 | 58.87 | 972 | 1,351 | 621 | 9,779 | 64.11 |
| Los Angeles Airways | 2,123 | 81 | 52.25 | 3,918 | 1,780 | ..... | 13,262 | 55.30 |
| Chicago Helicopter | ..... | ..... | ..... | 2,403 | ..... | ..... | 2,403 | 43.78 |
| **ALASKA** | | | | | | | | |
| Alaska Airlines | 6,497 | 1,779 | 53.38 | 29,484 | ..... | 280,359 | 509,222 | 53.37 |
| Alaska Coast | 5,472 | 484 | 67.60 | 4,457 | ..... | 4,238 | 58,153 | 68.81 |
| Cordova | 2,336 | 417 | 62.33 | 5,021 | ..... | 347,787 | 395,249 | 51.00 |
| Ellis Air Lines | 7,681 | 396 | 56.97 | 2,152 | ..... | 3,067 | 45,421 | 65.65 |
| Northern Consolidated | 2,586 | 774 | 53.60 | 21,210 | 280 | 299,647 | 406,609 | 80.67 |
| Pacific Northern | 11,609 | 9,173 | 51.69 | 74,786 | ..... | 317,310 | 1,383,458 | 64.92 |
| Reeve Aleutian | 940 | 476 | 68.99 | 12,725 | ..... | 42,882 | 106,471 | 75.23 |
| Wien Alaska | 3,610 | 1,489 | 17.68 | 27,774 | ..... | 942,627 | 1,124,285 | 91.62 |

*Not available.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

How fast t

MAN HAS TRAVELED over 1,900 mph. Already there's talk about 4,000 mph. Tomorrow it may be 10,000 mph. Is there a limit to the speed of tomorrow's aircraft . . . or even today's?

There may be. One of the many factors which will define this limit is steel.

t tomorrow?

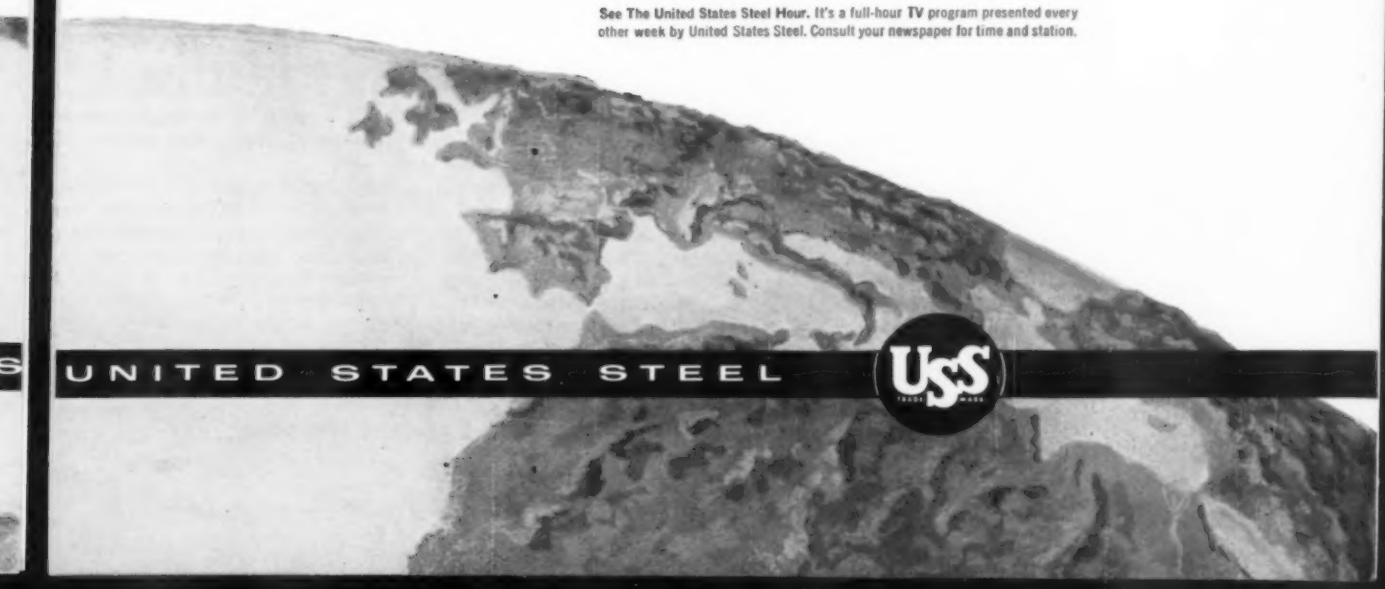
No presently available steel or any other material meets all the requirements for strength, corrosion resistance, fabricability and producibility. The strongest steels, in general, are the most difficult to fabricate. The most corrosion-resistant steels require the most critical alloying elements—elements that quickly become scarce in an emergency.

All the problems, all the possible solutions, have been studied for several years by United States Steel, with the cooperation of various airframe manufacturers. Intensive research continues on those steels that give the greatest promise of providing *optimum service* for *all* the diversified requirements of today's and tomorrow's aircraft.

You will find more detailed information on this problem and its solution in our new booklet, "Special Steels for the Aircraft of Tomorrow." Send for a free copy.

UNITED STATES STEEL CORPORATION, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

**See The United States Steel Hour.** It's a full-hour TV program presented every other week by United States Steel. Consult your newspaper for time and station.



UNITED STATES STEEL USS

Dawn-to-dark firing tests speed delivery of the mighty power plants that will thrust America's missiles into outer space.

# On the line...rocket engines for America's major missiles

Deep in the remote canyons of the Santa Susana Mountains, a bolt of flame knifes the sudden darkness of a California evening.

Obscured in the shadows – watching this man-made lightning flare and die as it has an untold number of times before – are the men of ROCKETDYNE... testing and tuning the giant propulsion systems they are building for the major missile projects of the Air Force, Army and Navy.

This amazing rocket engine workshop was planned as far back as 1947, about a year after ROCKETDYNE – in collaboration with the Armed Services – began a program of research that has led to accomplishments so fantastic, security restrictions forbid us to describe them.

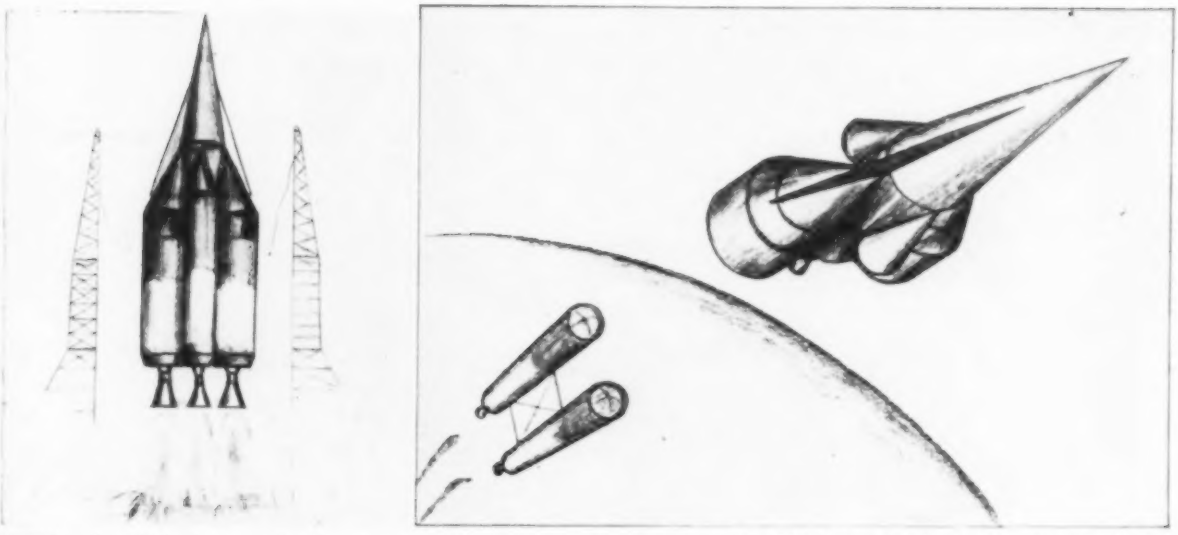
The fact that this work is so far advanced here in America is cause for sober confidence in our defense situation. It is good to know that these achievements are in the service of free men.

ENGINEERS: write for our brochure, "The Big Challenge," which tells you in detail what a career in rocketry can mean to you. Address: ROCKETDYNE, Personnel Manager, Dept. W-71, 6633 Canoga Avenue, Canoga Park, California; or Dept. W-71, Neosho, Mo.

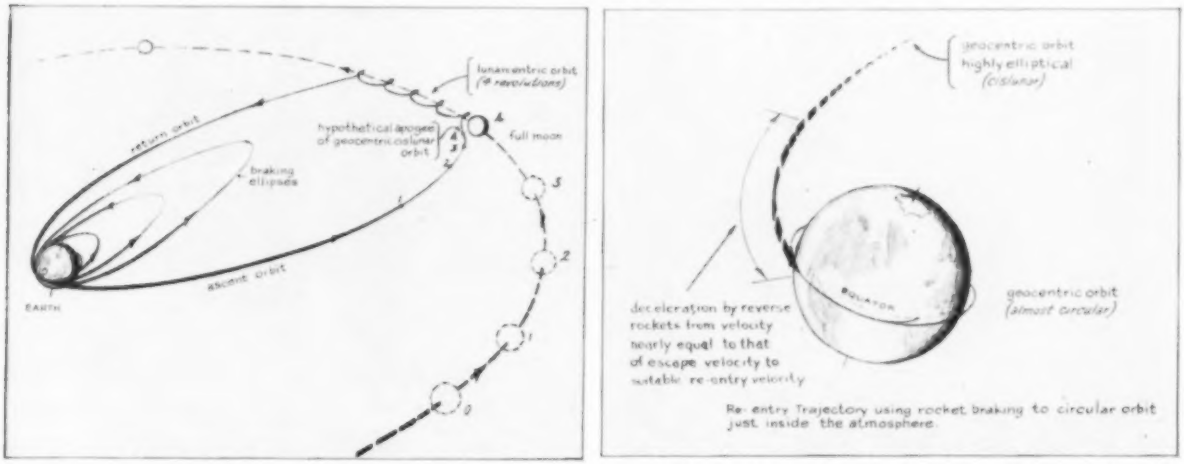
**ROCKETDYNE**

*A Division of North American Aviation, Inc.*

BUILDERS OF POWER FOR OUTER SPACE



**LUNAR** probe vehicle (left) uses liquid oxygen, alcohol in first two cluster type stage pairs. Third stage (right), atomic rocket with liquid hydrogen as working fluid, separates after 500 sec. boost. Aft pods store hydrogen, act as drag brakes in re-entry.




**NUMBERS** in lunar flight diagram (left) show relative positions of moon, vehicle. No. 1 is 25 hr., 2 is 50 hr., 3 is 75 hr. and 4 is 110 hr. Braking ellipses are used for re-entry. Powered braking return is shown in diagram at right.

# Company Formed to Study Space Design

By Irving Stone

**Sherman Oaks, Calif.**—Believing that now is the time to lay the groundwork for space travel, a group of scientists and engineers have initiated studies to establish feasibility of the various approaches.

Their company, Systems Laboratories Corp., was formed for preliminary design of basic systems for interplanetary travel.

Bolstering its initial studies, the company is establishing an immediate practical framework for its long-range aims by participating in existing advanced out-of-atmosphere missile projects.

Formed a little more than half a year ago, SLC is still a small company, selecting its professional staff with great care and including recognized authorities in such fields as trajectories and orbits, radar, electro-magnetic theory, dynamics, guidance and control, servomechanisms, materials, and nuclear engineering, physics.

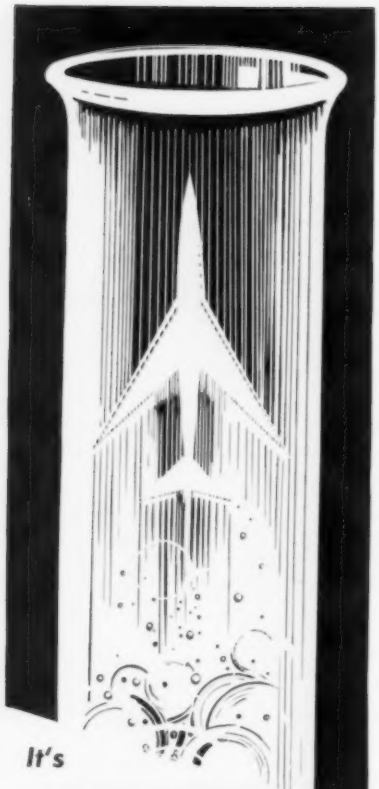
### Staff Breakdown

SLC now has 44 employes. There are 18 full-time engineers and scientists, an additional 6 employed part time, and 11 consultants, some of whom are scheduled to become full-time staff members.

The total includes 17 PhDs.

In effect, SLC is a closed corporation—its stock is not offered for public sale. All professional personnel associated with the company have invested in it, although this is not a requirement.

Founders are Dr. John L. Barnes; Richard H. De Lano, one of the co-holders of the Falcon missile patent, and Dr. James A. Marsh, who was head



*It's*

**AETCO**

for complete
testing of
aircraft components

*Write for book:*

*"How Aetco can help you."*

Aetco

**AIRCRAFT EQUIPMENT TESTING COMPANY**
1806-12 FLEET STREET
BALTIMORE 31, MD.
America's First Independent Aircraft Testing Laboratory
Hydraulic, pneumatic, electric (400 cycle, AC-DC) and mechanical
IN FLIGHT TESTING!

**TWO OF THE** founders of Systems Laboratories Corp., are Dr. John L. Barnes (left), president of the company, and Richard H. De Lano, secretary. Company was formed to create preliminary design of basic systems for interplanetary travel. Dr. Barnes is manipulating simple orrery, which demonstrates revolution of planets around sun.

of the radar group at North American Aviation's Downey plant.

Barnes, who is president, has had 27 years of professional experience. He is still professor of engineering at University of California, Los Angeles. During five years at North American Aviation he was chief of the Aerophysics Laboratory Guidance Section and associate director of the Electro-Mechanical Engineering Dept. Barnes also did consulting work for Ramo-Wooldridge Corp. on the intercontinental ballistic missile program. He was associated with Lockheed's Missile Systems Division for a short time, then became affiliated with Systems Research Corp. when that company was formed by former Lockheed personnel. Systems Research was taken over by Ford Motor Co. as Aeronutronic Systems, Inc., but Barnes chose not to go along, forming SLC with De Lano and Marsh.

### Merger Offers

In its relatively short existence, SLC already has had a number of offers to be absorbed by large companies, but isn't considering merger or other affiliation at this time, preferring to remain independent.

SLC has subcontracts in the field of missile systems from Republic Aviation Corp. These subcontracts encompass feasibility studies and study of various subsystems. Included are aspects of propulsion, navigation, control, and space dynamics (concerned with trajectories of vehicles outside the atmosphere—beyond 600 mi.).

The company also has subcontracts from two other large organizations and this work covers categories similar to those under the Republic subcontracts.

### Other Contracts

A number of other study contracts, also concerned with out-of-atmosphere vehicles, are being negotiated with industry companies.

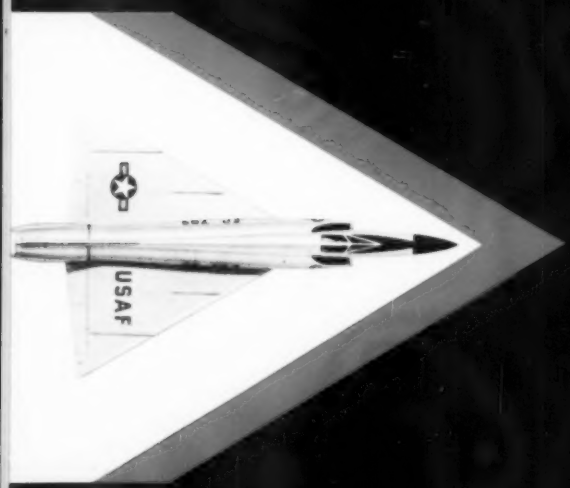
Emphasis of SLC's work under its subcontracts is on the scientific problems which must be solved before advanced engineering can be accomplished. These problems are associated with projected missile systems of a conceptual and scientific status far beyond that which exists today. Some of these systems apply to vehicles which are projected to operate beyond the atmosphere for extended periods of time.

Income from this subcontract work is what SLC lives on, bolstering its economic status to permit the expansion the company contemplates.

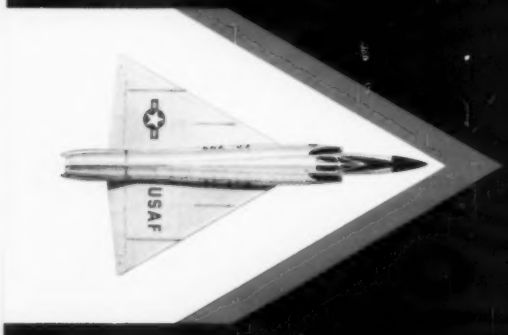
More important, this work is considered a key factor in advancing the company's fundamental aim—preliminary design of basic systems for interplanetary travel.

Meanwhile, SLC is devoting a good portion of its talent to the investigation of problems foreseen as associated with space travel of the near future, particularly to the nearest space body, the moon.

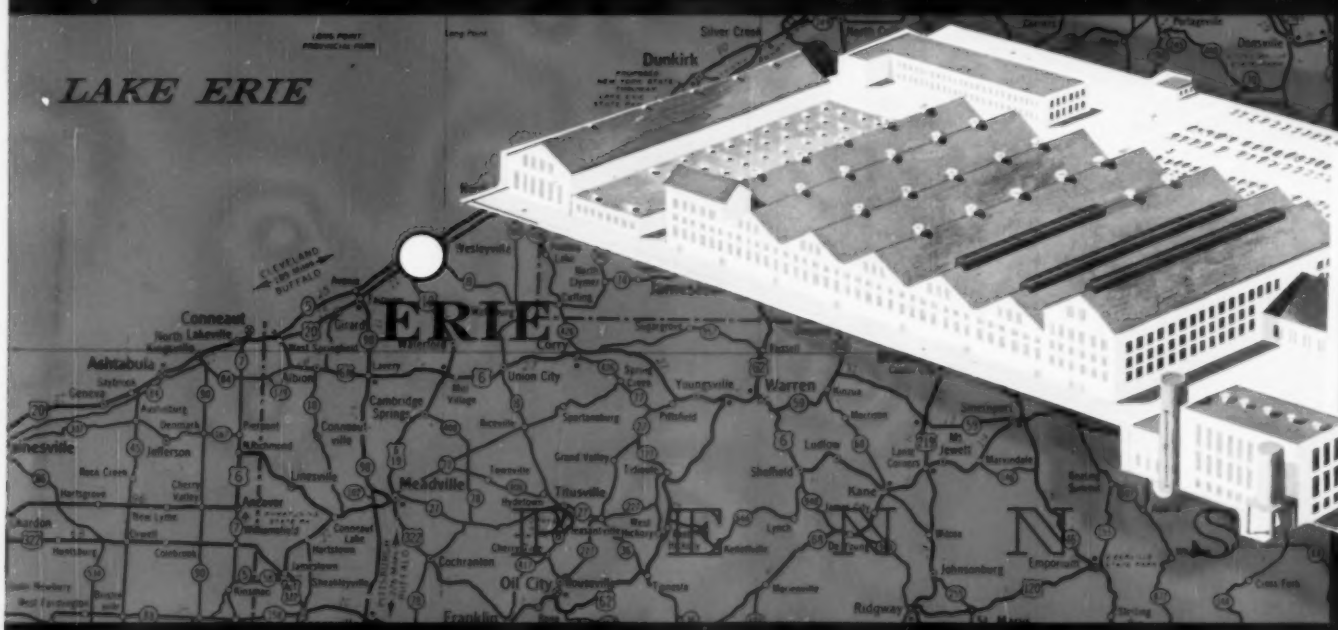
Barnes believes that within the next 15 years, if enough research and development support is available, a




ANOTHER THRUST FORWARD FOR FORGINGS...




# KAISER ALUMINUM BUYS ERIE FORGING PLANT



At Kaiser Aluminum we're planning big things for aluminum forgings . . . and we've just spent almost $3 million to prove it!

By buying our formerly leased forging plant at Erie, Pennsylvania, we have paved the way for a $5 million expansion program that will increase the plant's annual capacity by more than 6 million pounds and broaden the range of forgings.

In addition to the 31 pieces of forging equipment of various capacities at Kaiser Aluminum's Erie plant, two new hydraulic presses with capacities of 750 and 1500 tons have been installed and are already in operation.

Three more hydraulic presses with capacities of 3000, 5000 and 8000 tons will be in operation by December of 1957. New buildings and supporting equipment are also planned.

***What This Expansion Means to You***

Now Kaiser Aluminum can offer you larger, more complex aluminum forgings . . . made to even closer tolerances.

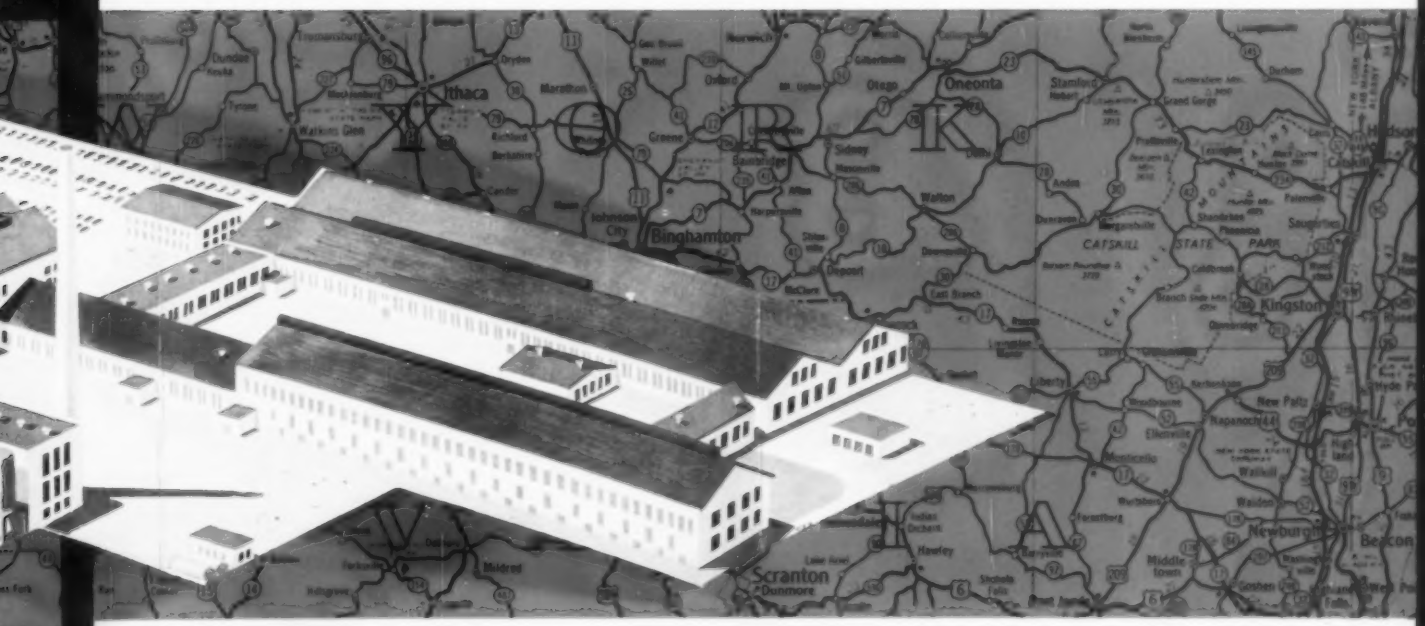
And with these new production facilities, Kaiser Aluminum can assure you of a larger supply of quality no-draft and standard aluminum forgings to meet your increased needs.

When you specify Kaiser Aluminum's forgings you have the assurance that they are backed up by the most modern die producing equipment, heat treating equipment and testing laboratories in existence.

The full resources of Kaiser Aluminum's Erie plant—a balanced combination of engineering skill, forging know-how and a wide range of modern equipment—are yours to draw upon.

For complete information, contact any Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., General Sales Office, Palmolive Bldg., Chicago 11, Illinois; Executive Office, Kaiser Bldg., Oakland 12, California.

# . . . PLANS $5 MILLION EXPANSION!

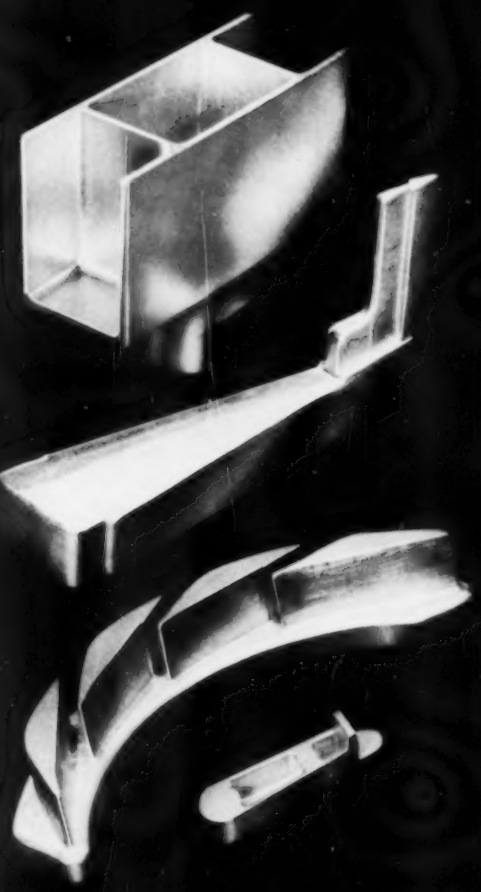


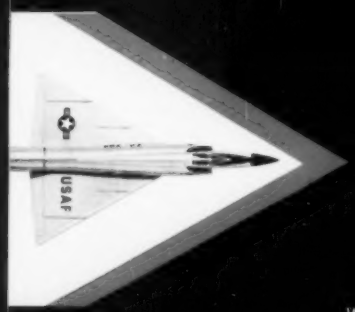

**Kaiser Aluminum**

***setting the pace—in growth, quality and service***

Located on a 57-acre site, the Erie plant presently has nine buildings covering 328,000 square feet. Die forgings up to 200 pounds in weight and hand forgings up to 2000 pounds may be produced with present equipment.

Kaiser Aluminum began operations at this plant in 1954 on a lease basis. Purchase and expansion of the Erie plan is part of Kaiser Aluminum's broad overall expansion program to better serve users of aluminum everywhere.



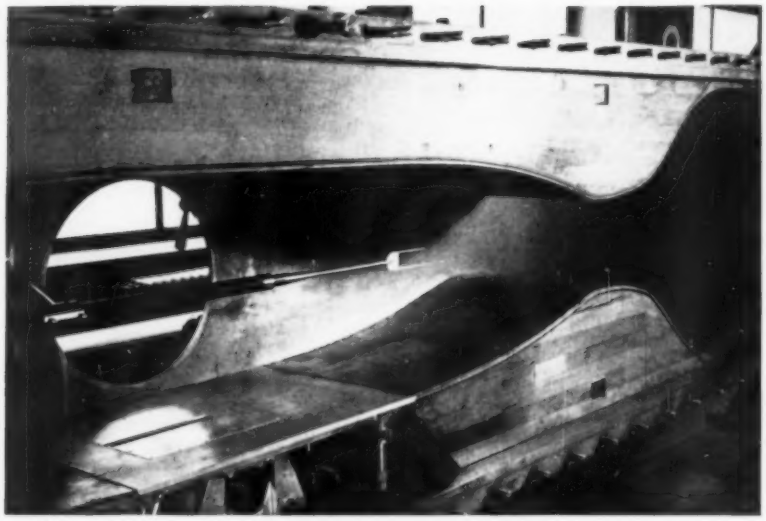



## 8 GREAT ADVANTAGES OF KAISER ALUMINUM FORGINGS

When you choose a Kaiser Aluminum forging you get all of these advantages:

1. The best combination of physical properties to meet a specific service condition.
2. Highest possible tensile and impact strength.
3. Controlled concentration of grain flow lines of strength at points of greatest shock and stress.
4. Reduction of dead weight by achieving maximum strength and toughness.
5. Maximum dimensional stability and uniformity.
6. Shorter machining and finishing time (in some cases no finishing is necessary).
7. Elimination of many sub-assemblies in complex parts.
8. Dependable end use performance through greater margins of safety in forged part.

***See "THE KAISER HOUR." Alternate Tuesdays, NBC Network. Consult your local TV listing.***



## NATO Wind Tunnel

**Supersonic 16 × 16-in. wind tunnel is one of the facilities at the new Training Center for Experimental Aerodynamics, a joint Belgian-U. S. project at Rhode St. Genese, Belgium. (AW Oct. 22, p. 66). Tunnel is capable of speeds up to Mach 2.3.**

manned space vehicle can circle the moon and return to earth safely. He believes that within the next 5 to 10 years vehicles carrying instruments only will make the lunar trip.

SLC sees its field of study to be vital because, first, space travel will be a natural development of continued aeronautical progress, and, secondly, accomplishment of space travel will be accelerated to provide data on global weather phenomena, composition of cosmic radiation outside the atmosphere, amount of cosmic material traveling through space, and observation of astronomical bodies without obscuration and distortion by the earth's atmosphere.

### Data Comparison

SLC's scientists and engineers are accumulating data (including experimental data which has been obtained with sounding rockets), comparing it with existing theories, and formulating improved theory, as indicated, to fit the data.

This general approach is directed to anticipated difficulties associated with interplanetary vehicles in such areas as:

- **Propulsion.**
- **Communication.**
- **Navigation.**
- **Bio-psychological environment.**
- **Interaction between subsystems.**
- **Atmospheric re-entry.**

Barnes believes that the satellite refueling stations which have been widely proposed for travel to the moon will be avoided through the use of nuclear fission rocket propulsion, which probably will be superseded by a nuclear fusion (controlled thermonuclear reaction) rocket engine. The fusion engine will use more available ingredients (deuterium and tritium) and will not be radioactive per se.

The fission engine will be a practical engineering reality for instrumented vehicle application within five years, Barnes believes. The nuclear fusion rocket engine will be developed to the stage of being feasible in that same period, he feels.

With either of these engines, extended travel, as to a distant planet, will introduce the problem of carrying an adequate supply of thrust material. Attempting to contribute to the development of these rocket powerplants, SLC is formulating design criteria for the use of hydrogen or helium as the thrust-generating medium, with the reactor supplying the heat for accelerating the gas particles through an exit nozzle.

### Thrust Augmentation

Another phase of this study is to determine whether it is feasible to augment the thermally generated thrust by increasing the ionization of the gas to add an electrically generated thrust, using extension of the principles used in laboratory linear accelerators. Big job here will be to spread the accelerating force over the cross-section of the mass of gas, if thrust is to be increased measurably.

With the nuclear fusion engine, the big problem will be to create a "container" for the small artificial sun created by the fusion of deuterium and tritium atoms. SLC is formulating theory to provide a practical answer for

BUCKETS and BLADES for AGT

We design and build:

- Forge Dies
- Trimming Dies
- Investment Molds

We machine to *

- Forgings
- Solid Stock
- Investment Castings
- Centrifugal Compressor Wheels

*Your specifications

TURBINE AIRFOILS DIV.

Therm-electric METERS CO., INC.

Ithaca, New York

All-weather performance of the F-102A at supersonic speeds demands perfection in every vital plane part. That's why Camloc's SPF (Stressed Panel Fastener) is used to secure highly stressed access panels... SPF's have continuous thread engagement, no cross threading, long torque life.

A fast and sure fastener for a fast and sure interceptor!

CAMLOC®

FASTENER CORPORATION

22 Spring Valley Road, Paramus, N. J.

WEST COAST OFFICE: 5410 WILSHIRE BLVD., LOS ANGELES, CAL.

the control and containment of the reacting materials. One approach it contemplates is to create a container in the form of an "electro-magnetic bottle" as suggested by Dr. Edward Teller of the University of California, Berkeley.

A proposed configuration for an initial lunar vehicle would use the nuclear fission rocket engine in a central body, surrounded by two pairs of boosters using chemical rockets for boost through the earth's atmosphere. Trajectory control would be through gimballing the main rockets and through auxiliary jets.

Difficulties are foreseen in transmission of radio (including radar) waves through ionized gases which will be encountered in the upper atmosphere. This ionized state will be caused by solar radiation, supersonic or hypersonic shock waves and boundary layer conditions, and by rocket exhaust.

Outside the atmosphere, ionization will still be present in the rocket exhaust, and transmission through this gas will pose problems.

SLC is investigating the optimum frequencies for transmission through ionized gases and exploring the design of missile antennas for most efficient transmission and reception.

Another possibility being considered is to use the ionized boundary layer as an antenna.

This approach may prove feasible because of the conductivity of the ionized gas.

### Uncharging Ions

Ionization in the exhaust from a chemical rocket engine might be reduced by the use of additives in the propellants. These additives would facilitate the recombination of ions into uncharged atoms.

Exhaust from a nuclear fission rocket engine could be especially troublesome if the thrust material (hydrogen or helium) becomes radioactive as it is heated in the reactor. One scheme being advanced by SLC is to isolate the thrust gas from the radiation of the reactor by using, for example, liquid sodium to transfer reactor heat to the gas.

For long out-of-atmosphere trips, such as to the moon, inertial navigation, almost certain to be used, will require correction of gyro drift, Barnes declares. SLC is considering various methods for accomplishing this correction. One is through observation of the relative position of the sun (or other stars), earth or moon. This observation would be done automatically by photo-electric equipment, using infra-red visual and ultra-violet radiation frequencies.

Another method, which might be used to supplement this procedure, is to follow the vehicle by radar from the

earth and communicate this position to the vehicle. This would involve the design of an extremely long-range radar with a sufficiently narrow beam with enough energy to excite a radio beacon in the space vehicle to return a pulse to earth for determination of distance and direction of the vehicle (AW Sept. 3, p. 82).

### Human Factors

Approaches to overcome some of the biological and psychological problems arising from the environment of space travel are being planned by SLC scientists. One scheme tagged for study is the introduction of an artificial force field to compensate for the absence of gravity. One possibility is the use of centrifugal force which could be introduced by rotating the passenger cabin within the vehicle. This, for example, would permit the passenger to swallow food and would prevent mental disorientation.

For protection of personnel from solar radiation, SLC is contemplating the design of optical filters.

For protection from cosmic radiation and impact from small meteoric particles, SLC scientists are beginning to think about materials which would be feasible for vehicle skin and personnel shield as well. This would afford minimum mass and design simplicity.

SLC system philosophy is to avoid optimum design of individual subsystems without regard to relation to other subsystems. Present studies are attempting to find best distribution of the total allowable mass among the various subsystems. Aim of this general study is to achieve an economic gross weight.

### Heat Problems

Studies also are being projected to determine optimum location of subsystems to minimize interaction effects of solar and internally generated heat, as well as effects of nuclear radiation from the fission reactor section of the rocket powerplant.

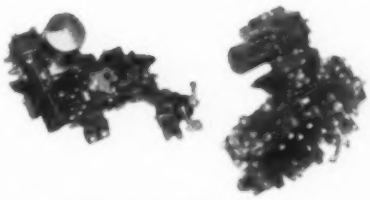
Though re-entry into the earth's atmosphere will be the homestretch of the space trip, Barnes sees it as one of the toughest phases to complete.

SLC scientists are now considering various methods for overcoming the heating problem of re-entry. One method which now appears reasonably feasible and which is projected for detailed calculations is the trajectory of a gradually tightening spiral approach wherein the earth is circled in the thin upper atmosphere to achieve the slowdown required for passing through the lower, denser air.

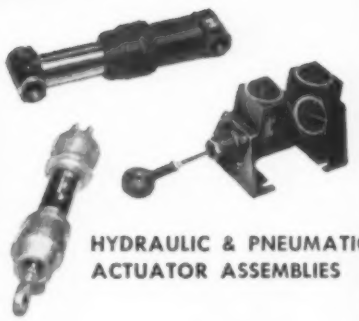
Also playing an important part in the re-entry phase will be determination of thermal-aerodynamic and ionization behavior of hypersonic flow in a "tapered"


XLO
EX-CELL-O for PRECISION

Ex-Cell-O Precision at Production Prices

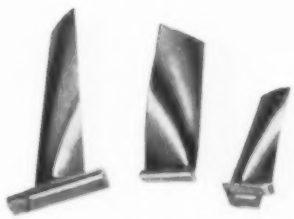


FUEL CONTROL AND METERING ASSEMBLIES



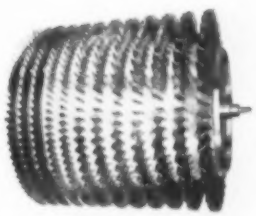
HYDRAULIC & PNEUMATIC ACTUATOR ASSEMBLIES

FUEL NOZZLES FOR JET ENGINES



JET ENGINE BLADES

MISCELLANEOUS AIRCRAFT AND COMMERCIAL PRECISION PARTS



JET COMPRESSOR ROTORS

Ex-Cell-O's facilities include laboratory control of materials, design and process engineering, machining of all materials, complete quality control to meet the most rigid specifications, and delivery to meet customers' requirements.

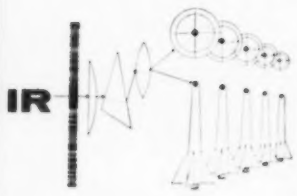
For information or a quotation, write or phone the Precision Products Division of Ex-Cell-O.

54-3

EX-CELL-O CORPORATION • DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

INFRA-RED IS
ULTRA-MODERN



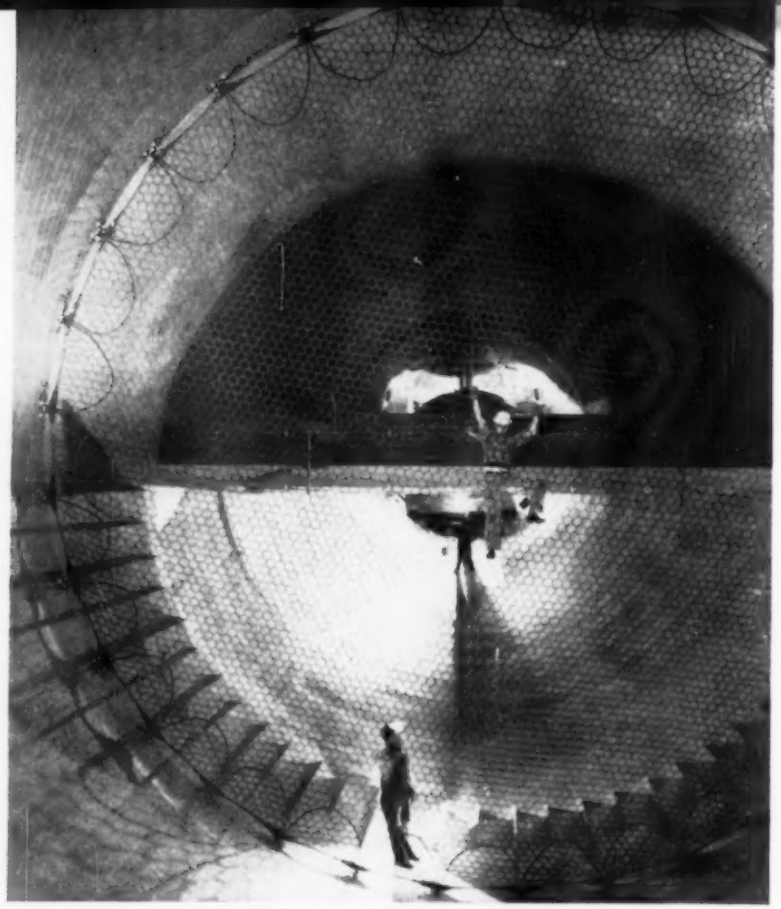

In the post-war years, the development of infra-red devices has attained the dimensions of a technological breakthrough. In this period, the Electronics and Guidance Division of Aerojet-General Corp. has become the national leader in the development and manufacture of infra-red equipment.

Aerojet offers qualified engineers and scientists unparalleled opportunities in every area of the guidance and propulsion field.

Electronics Engineers
Physicists
Mechanical Engineers
Chemical Engineers
Electrical Engineers
Aeronautical Engineers
Civil Engineers
Metallurgists
Chemists
Mathematicians
Technical Editors

Aerojet-General
CORPORATION
A Subsidiary of The General Tire & Rubber Company
THE GENERAL TIRE
PLANTS AT AZUSA AND NEAR SACRAMENTO, CALIFORNIA

Write: Director of Scientific and Engineering Personnel, Box 296N, Azusa, Calif. or Box 1947N, Sacramento, Cal.

## Transonic Safety Net

**Heavy duty screen is downstream of test section in Arnold Engineering Development Center transonic wind tunnel. Purpose of net is to catch possible flying debris before damaging 225-ton whirling compressor. Net is made up of thousands of strands of steel cable designed to absorb as much as 200,000 ft./lb. of kinetic energy.**

(thin-to-dense) atmosphere for the purpose of establishing the optimum shape of the vehicle. SLC scientists contemplate that improved hypersonic flow theories will be required to fit the experimental data currently being generated.

This will take into account ionization effects on amount of heat being generated and will permit better predictions on point of transition from laminar to turbulent flow.

Other methods of re-entry slowdown projected for theoretical study at SLC include use of air brakes, jet brakes, and a combination of these.

## Computer Can Shorten Data Reduction Work

New electrically driven analog computer performs harmonic analysis and curve fitting and can be used by relatively inexperienced operators. It is manufactured by Gerber Scientific Instrument Co. and is being marketed for $1,350.

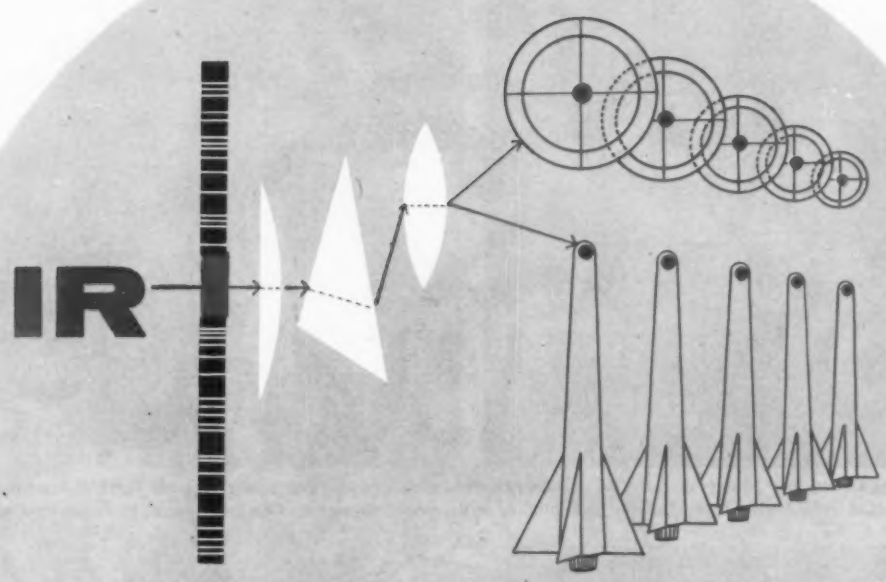
The unit will analyze a curve in terms of a Fourier series, a power series or an orthogonal polynominal and produce a slope equation or an integral equation of the curve.

The answers are recorded on a program sheet specifically designed for each type of analysis.

Fourier coefficients can be determined for 48 constants. Power series coefficients can be determined to the eighth power. Least square equations for curves fitting arbitrary test points can be obtained to the fifth power and up to 50 equally spaced points.

The equameter can fit power series equations to curves or test points for use in automatic digital computers without expensive analog to digital converters and considerable amounts of engineering time.

An engineering aide equipped with an equameter can free an engineer from data reduction work and reduce the time required for the operation. He can perform a twelve term Fourier analyses in less than ten minutes and get a fourth power fit on a recorded or plotted curve in approximately the same time.




# INFRA-RED

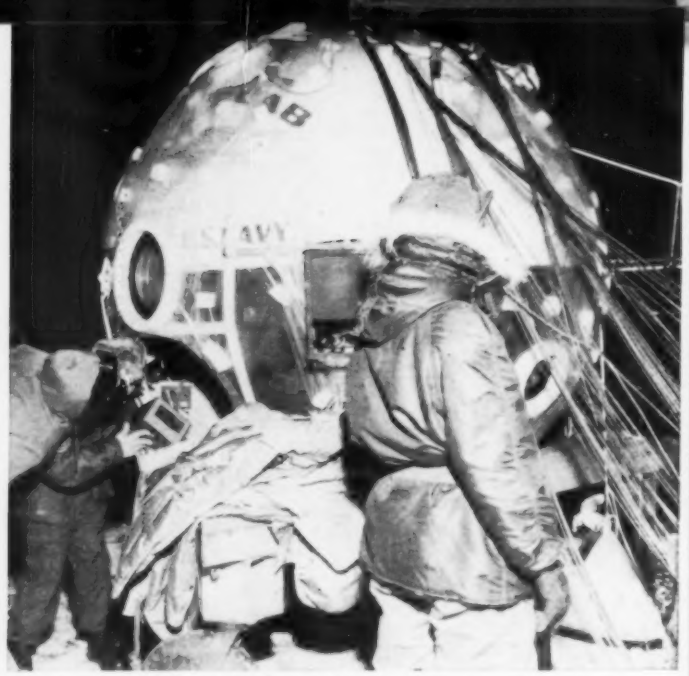
## 1944...RESEARCH • 1956...MASS PRODUCTION

For 13 years Aerojet-General has pioneered the research and development of infra-red devices. *Now*, Aerojet and *Aerojet alone* has perfected the high-volume production of infra-red systems for:

GUIDANCE
WIDE-ANGLE SEARCH
AUTOMATIC TRACKING
GUNFIRE CONTROL

Aerojet-General CORPORATION
A Subsidiary of The General Tire & Rubber Company
AZUSA, CALIFORNIA
SACRAMENTO, CALIFORNIA

Electronics engineers...physicists...Aerojet invites you to pinpoint your own targets, "lock on" your own future... in the dynamic new field of infra-red.

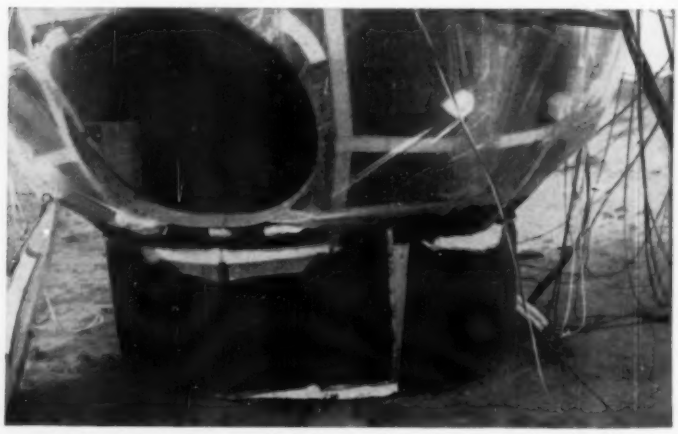


**INFLATING** the 128 ft. diameter balloon in pre-dawn darkness an hour before take off (left) at Stratosphere Bowl, N. D. Ground crew (right) loads the spherical gondola with special apparatus. Gondola appears to be covered with plastic.

**PLASTIC ENVELOPE,** only .0025 in. thick, lifts gondola. Note parachute.

# Balloon Reaches 76,000 ft.

New, manned balloon altitude record of 76,000 ft. was set by Lt. Cmdrs. M. D. Ross and M. L. Lewis on Nov. 6. (Old record of 72,394 ft. was made in 1935.) Plastic envelope had a capacity of 803,000 cu. ft. of helium. Total weight lifted was 2,150 lb. of which balloon, lines and parachute weighed 705 lb.; crew and personal gear 380 lb.; gondola and fittings 500 lb.; equipment and supplies 256 lb., and ballast, 300 lb. Flight took off at 6:19 a.m. and landed at 10:23 a.m. for a duration of 4:04 hr. Balloon made a rapid descent because of a malfunctioning automatic helium valve which was designed to remove the balloon's free lift. In spite of the sudden drop, the balloonists suffered no injuries and the gondola remained intact. The Office of Naval Research, which sponsored the flight, has not revealed what high altitude data was collected as a result of the flight, nor when and if another will be attempted soon.



**CLOSE-UP** of the lower part of the gondola shows a loading hatch and a special, shock-absorbing base to cushion the landing impact. Base was built like a cargo drop platform.

# A DIRECT CHALLENGE

## TO THE PRODUCTION DESIGN ENGINEER

The Design Engineer at Rohr is engaged primarily in the tremendous field of power packages and power plant components, plus related structural design . . . the translation of theoretical into production design with consideration for serviceability, function, materials, and integrity encompassing all engineering factors that enter into design of the complete aircraft itself.

Here's the direct challenge you seek — the personal reward you desire. Because here, at Rohr, engaged in the practical design of ready-to-install aircraft power packages, your association is direct to the manufacturing of the item. You actually see what your design produced.

And, of course, lovely Chula Vista, California, located on beautiful San Diego Bay, offers you and your family the wonderful, outdoor, semi-tropical living you've dreamed of.

If you are experienced as a production design engineer, looking for the direct challenge and reward, and a better life, write Rohr now!

Please enclose full resume and we will answer at once. J. L. Hobel, Industrial Relations Manager, Rohr Aircraft Corporation, Chula Vista, California, Dept. 33A.

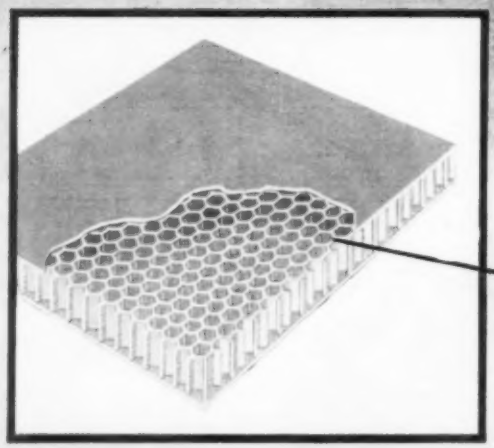
WORLD'S LARGEST PRODUCER OF READY-TO-INSTALL POWER PACKAGES FOR AIRPLANES

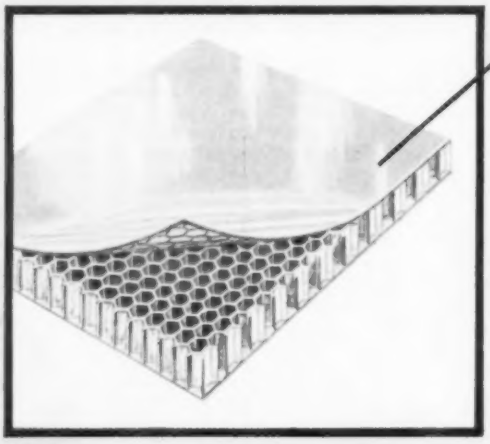
ROHR
AIRCRAFT CORPORATION

PLANTS IN CHULA VISTA AND RIVERSIDE, CALIFORNIA; WINDER, GEORGIA; AUBURN, WASHINGTON

# Brunswick ... your prime source for aircraft sub-assemblies

Advanced techniques and facilities in the areas of reinforced plastics, metal honeycomb and conventional metalwork have made Brunswick a prime supplier to the nation's leading airframe manufacturers. One important new addition to the defense air arm combines *all three* types of construction in one single component manufactured by Brunswick.





### REINFORCED PLASTICS

In the field of reinforced plastics, Brunswick continues to offer experience and facilities involving the broadest range of materials and applications. Honeycomb core, foamed in place, solid laminate and anti-icing fabrications of virtually all sizes are currently in service and in quantity production.

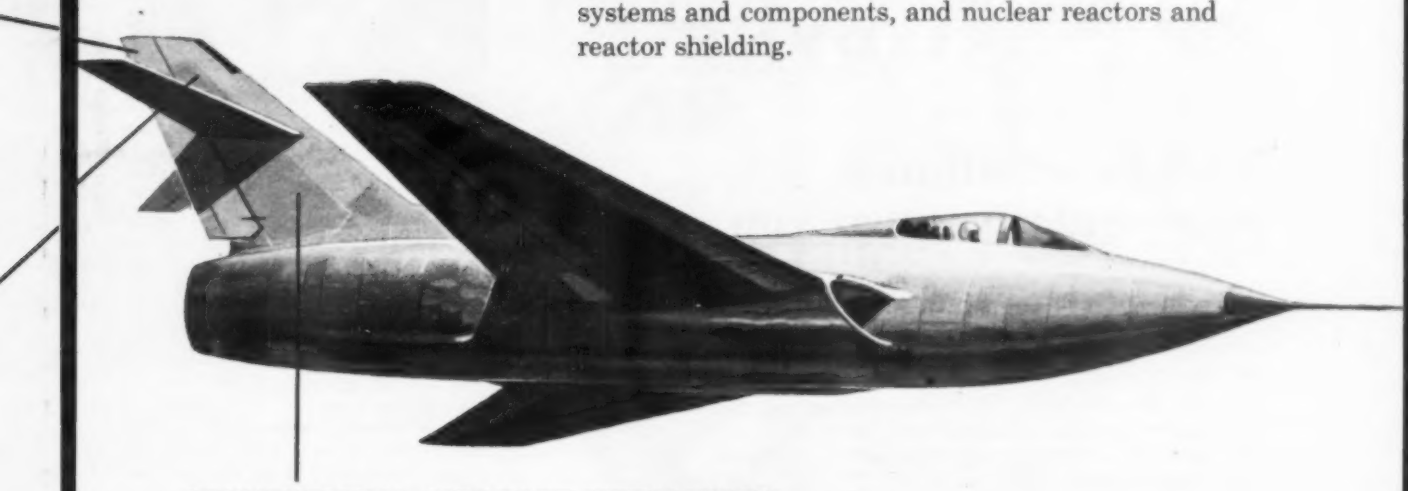
### METAL HONEYCOMB FABRICATIONS

Brunswick is skilled in manufacturing techniques that make possible the fabrication of metal honeycomb components calling for exceptionally close tolerances and compound curvatures. The result: metal honeycomb is now being used in a wider and wider range of components such as engine nacelles, bomb bay doors, nose wheel doors, trailing edges and control surfaces, numerous internal and external structures.

Exclusive agreement
adds facilities of

## Technical Research Group

This combination of the skills of T.R.G. and Brunswick places at your disposal the most advanced techniques in design, development and production of radomes and low frequency antenna housings. Technical Research Group is a senior scientific organization providing design, development and research services to industry and the government in the fields of mathematics, physics and chemistry. It has earned its initial reputation in the development and study of electromagnetic theory, radar systems and components, and nuclear reactors and reactor shielding.



**CONVENTIONAL AIRCRAFT METALWORK**

Brunswick continues to supply the industry with such components as pressurized windshield and canopy assemblies, major radar assemblies and ailerons and flaps. Whatever the problem, whatever the materials . . . a discussion with Brunswick could prove valuable to you.

**THE BRUNSWICK-BALKE-COLLENDER CO.**

623 South Wabash Avenue, Chicago 5, Illinois

**NEW**

**CALIDYNE model 174 SHAKER**

**1500 lbs. force output**

**a basic shaker for 6 different Vibration Test Systems**

| SYSTEM NUMBER | 1 174/323 | 2 174/184 | 3 174/80 | 4 174/186 | 5 174/186 | 6 174/80 |
|---|---|---|---|---|---|---|
| Type | Sinusoidal | Sinusoidal | Sinusoidal* | Sinusoidal* | Random or Sinusoidal | Random or Sinusoidal |
| Power Supply | Electronic | Rotary | Electronic | Electronic | Electronic | Electronic |
| Force Output | 1250 lbs. | 1500 lbs. | 1500 lbs. | 1500 lbs. | 1500 lbs. | 1500 lbs. |
| Frequency Range | 5-3300 cps. | 5-2000 cps. | 5-3300 cps. | 5-3300 cps. | 5-3300 cps. | 5-3300 cps. |
| Max. Load 10 g. | 105 lbs. | 130 lbs. | 130 lbs. | 130 lbs. | 130 lbs. | 130 lbs. |
| Max. Load 20 g. | 42.5 lbs. | 55 lbs. | 55 lbs. | 55 lbs. | 55 lbs. | 55 lbs. |

*Also adaptable for Random Vibration Testing.

CALIDYNE'S Model 174 Shaker featuring high frequency operation and low input requirements has been so designed that it can be utilized in any one of six CALIDYNE Vibration Test Systems.

The versatility of the Model 174 Shaker extends the range of vibration testing for which this shaker can be used. It further advances CALIDYNE Systems of vibration control, enabling equipment manufacturers to: create vibratory forces over a wide range, measure them, use them for testing and measuring the test results.

Typical vibration testing applications of these Model 174 CALIDYNE Shakers include:

1. **Brute force** shaking at frequencies simulating the worst conditions of ultimate operation.
2. **Structural response** to determine mode shape, frequency and damping characteristics.
3. **Fatigue testing** for high stress providing deflections far greater than normal usage.
4. **Random** vibration testing for more exact simulation of true environment.

For further information call (Boston) Winchester 6-3810.

THE CALIDYNE COMPANY

120 CROSS STREET WINCHESTER MASSACHUSETTS



# There's a Stillman representative near you...

... with the answers to your O-ring, rubber-to-metal bonding and rubber molding problems. Ask him about PERMADIZING, Stillman's exclusive high-quality rubber-to-metal bonding process that provides precise, flash-free parts of optical smoothness. Write or call your nearby Stillman representative today.

*Stillman has the answer...*
*PERMADIZING*

**Stillman Rubber Co.**

5811 Marilyn Ave., Culver City, Calif.
23525 Lorain Rd., Cleveland 26, Ohio


## PRODUCTION BRIEFING

**Cleveland Cap Screw Co.**, Cleveland, Ohio, is making 50 4½ in. diameter screws for the nozzle assembly of the supersonic propulsion wind tunnel at Arnold Engineering Development Center, Tullahoma, Tenn. The cost will be about $6,000. Made of AISI 4140 (high-carbon chrome molybdenum

steel), the heads and shanks are machined and the threads formed on a centerless grinder. Following heat treatment to a Rockwell C hardness of 38-42, they are ground to a super fine 32 micro inch finish on cylindrical grinders, and silver plated over a nickel undercoat. Screw shown weighs 80 lb.

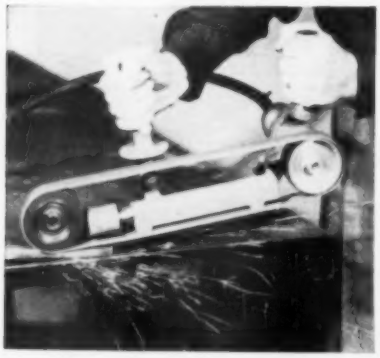
**Kaiser Aluminum & Chemical Corp.**, Oakland, Calif., will add extensive facilities for the production of aluminum plate to the sheet and foil rolling mill now under construction at Ravenswood, W. Va. What Kaiser calls "the world's largest stretcher" will be used to stress relieve aluminum plate up to six inches thick.

**L. A. Young Spring and Wire Corp.**, Detroit, Mich., acquired the assets of Extruded Hinge Co., Ypsilanti, Mich., for $600,000.

**All-State Welding Alloys Co.**, White Plains, N. Y., has developed a line of alloys and fluxes which make it feasible to weld aluminum to steel, stainless steel, monel, nickel, copper, brass.

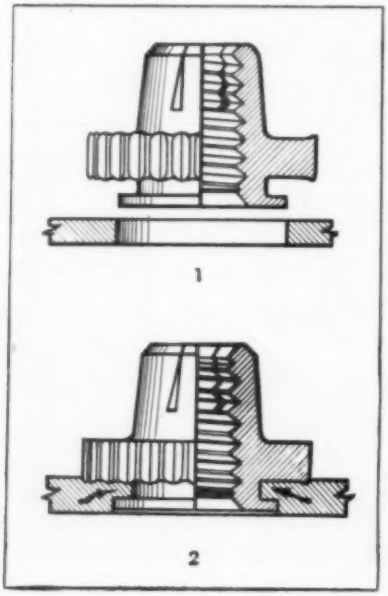
**Weatherhead Co.**, Cleveland, Ohio, organized a new corporation to acquire the assets of Eastern Aircraft Products Corp. and Eastern Precision Parts Co., Orange, N.J. The name and operations

of the Eastern companies, which make self-sealing quick disconnects, breakaway couplings, valves and electro-mechanical devices, will be continued.



**Grinding & Polishing Machinery** Corp., Indianapolis 5, Ind. has an improved version of a portable abrasive belt hand tool. Model 3-36 weighs 6¾ lbs. and is air driven at 4,700 sfpm.

**Part of the Air Force's** heavy press program, an 8,000-ton extrusion press is now in full production at Harvey Aluminum, Torrance, Calif. A companion 12,000-ton press is nearing completion. Advantage of extrusion presses is that dies for complicated cross sections can be made easily for new designs. Thus built up sections of angles, etc., can be replaced by efficient, specially-shaped spars with cross-sections tailored to the design.




**New Press-Nut** is held in sheet metal by cold flowing of the parent metal upon assembly impact. Designed to meet government specifications, the self-locking nut is made by Rosan, Inc., Newport Beach, Calif.


The NEW SCOTTORAMIC FACE MASK with VISION UNLIMITED

Protects Crew from • Smoke • Fumes • $CO_2$ after use of fire extinguishers

The ideal mask for pilot and crew in every type of military and civil transport service. The SCOTTORAMIC is an entirely new concept in modern face mask design which affords pilots the vital side vision necessary for safe, smooth landings. And pilots don't object to wearing the Scottoramic because its soft contour-fit keeps it comfortable even when worn for long periods of time.

The double-edge face seal safely blocks out smoke and fumes. Non-fogging is assured by "circle-flow" ventilating action that air-washes the lens on each inhalation. Mike installations are also available.

The SCOTTORAMIC Face Mask gives you all these features plus the greatest advance in the history of protective mask design . . . "Vision Unlimited!"

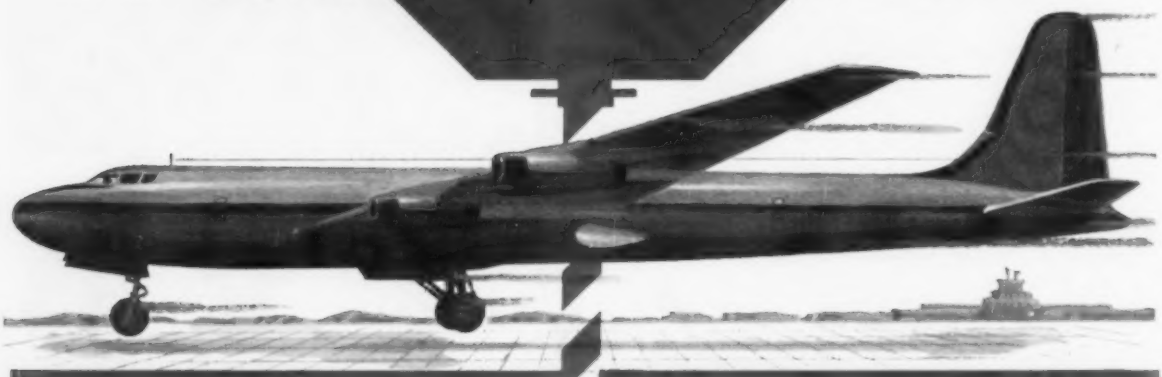
SINCE 1932

*Write for complete specifications.*

SCOTT AVIATION CORP.
225 ERIE STREET LANCASTER, NEW YORK
Export: Southern Cyprus Co., 11 W. 42th St., New York 19, N.Y.

# CONTROLLED STOP

## ...with Bendix-Pacific POWER BRAKING



Bendix-Pacific has maintained its leadership in keeping pace with today's high speed deceleration problems, providing the latest aircraft with extra fast braking response.

Bendix-Pacific can provide positive, fast braking under any normal or emergency condition, including full functioning with anti-skid devices.

Do you have a braking problem? A qualified Bendix-Pacific Sales Engineer is available to discuss your potential requirements.

COMING SOON . . . Bendix-Pacific ANTI-SKID

Bendix
PACIFIC DIVISION
"Bendix" Aviation Corporation
NORTH HOLLYWOOD, CALIF.

Bridgeport, Conn. • Dallas, Texas • Dayton, Ohio • Washington, D.C.

LEVER OPERATED

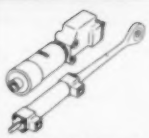
PLUNGER OPERATED

MASTER BRAKE CYLINDERS

POWER BOOSTED MASTER BRAKE CYLINDER

COMBINATION POWER AND MASTER BRAKE VALVE

EMERGENCY BRAKE (HYDRAULIC AND PNEUMATIC)



MASTER AND SLAVE COMBINATIONS

**RAMJET NOZZLE LINER** (left) and ramjet nozzle housing (upper and lower right) are two Curtiss-Wright subcontractor-made parts which match in size and placement of attachment fittings. They probably are for the North American Navaho missile. The 48-in. diameter ramjet on which these would be used would have a thrust of 30,000-40,000 lb.

# Subcontractors Build Navaho-Size Nozzle

By Robert Cushman

Two Curtiss-Wright ramjet parts remarkable for their large size and sophistication are in limited production, probably for the Navaho missile. Most declassified ramjet hardware to date has been "boiler-plate" for wind tunnel research.

One of the parts, a ramjet nozzle liner is being made in small monthly quantities by T. R. Finn Co., Hawthorne, N. J. A nozzle housing is being made in similar small quantities by Lycoming Division, Avco Corp., Stratford, Conn.

The large size of these parts—the Lycoming nozzle is 48 in. diameter and 45 in. long—indicate that a ramjet using these parts could have a net thrust on the order of 30,000 to 40,000 lb. at Mach 2 or 3 at 50,000 to 70,000 ft. Navaho has two Curtiss-Wright ramjets and therefore total thrust would be in the vicinity of 60,000 to 80,000 lb. (AW Nov. 19, p. 23).

That the two parts are related is indicated not only by the dimensions of the Finn liner, which could fit nicely inside the Lycoming nozzle, but the 30 attachment clips on the liner match the 30 fastening devices inside the Lycoming part. Space between the parts would be used for cooling fluid.

## Fabrication Details

Both are made of Inconel. The liner is made by a proprietary Finn process which uses a series of specially designed rolls to cold form the metal sheets. Basis of the process's success, the inventor, Charles Brunstetter, said, is that certain dimensions are shrunk stretching others. This prevents the uncontrollable "growth" of the part that occurs during most competitive methods of forming.

The eight (since reduced to two) sections so formed are heliarc welded together. The final weld (shown held by clamps) would probably not be made until the liner has been fitted inside the nozzle. The corrugations are for rigidity and thermal expansion.

Finn said that its proprietary method, called "shrink-stretching," is much faster (one-tenth the time) and cheaper (one-fifth the cost) than spinning.

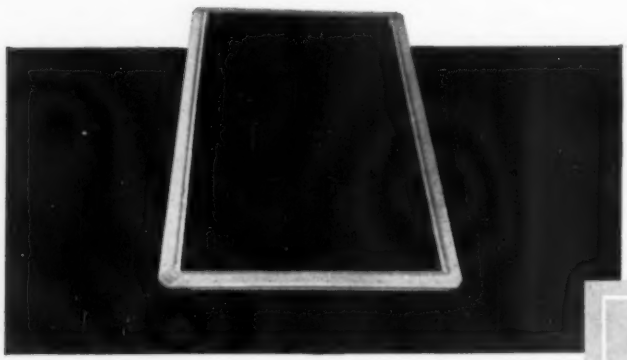
The Lycoming nozzle assembly which would bolt to the aft end of the ramjet's combustion section, is made from a number of spun rings welded together. Lycoming says that it is the largest diameter sheet metal component ever produced for an aircraft engine. Because of Inconel machining difficulties, Lycoming uses a high speed tool with very light cuts and low surface speed. The thin .05 in. flanges must be supported by a cerrotru interior filling for the final truing up of the complete weld.

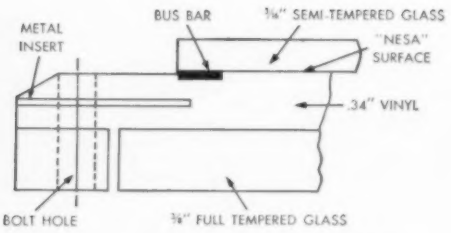
## Low-Alloy Metal

Cerrotru is a low-alloy metal which can be melted out with boiling water after machining is finished.

Finn shrink-stretch process, Brunstetter said, is good for forming accurate compound contour sheet metal parts from $\frac{3}{8}$ in. thick down to .005 in. thick. He said it is almost the only way of forming certain aircraft parts out of the high temperature super-alloys such as Inconel-X, Inconel-W, N-155, the Hatelloys and Uniloys.

# Good visibility for Boeing B-52 pilots with electrically heated "NESA"® windshields






*A report from*

**THE PITTSBURGH AIRCRAFT GLAZING FILE**

Just about everybody has seen pictures and heard of the 400,000-pound Boeing B-52 long-range heavy bomber.

At extreme altitudes, it will fly more than 6,000 miles without refueling—and on trips like this, the pilot must be prepared for any kind of weather. As far as visibility is concerned, he is prepared with a NESA Flexseal® electrically heated windshield. The 3/16" semi-tempered outer glass ply has the NESA coating on the inside surface to protect against icing and fogging.

Pittsburgh Plate has developed many special aircraft glasses, and our Technical Representative will be glad to discuss them with you and help solve any of your difficult aircraft glazing problems.

For more information, write to Pittsburgh Plate Glass Company, Room 6415, 632 Fort Duquesne Boulevard, Pittsburgh 22, Pa.

PAINTS · GLASS · CHEMICALS · BRUSHES · PLASTICS · FIBER GLASS

**PITTSBURGH PLATE GLASS COMPANY**

IN CANADA: CANADIAN PITTSBURGH INDUSTRIES LIMITED

## WHAT'S NEW

### Reports Available

• **Theory and Design of Servomechanisms**—by J. C. Gille, M. Pelegrin and P. Decaulne-Pub. by Dunod, 92 Rue Bonaparte, Paris 6e, France. $28.90 including postage; 700 pp. The book is directed at servo engineers and designers, principally in the aeronautical field. It includes a section dealing with the philosophy of Cybernetics. The five sections of the book are labeled: Linear Dynamics, Linear Servosystems, Nonlinear Servosystems, Servocomponent Design, and Servosynthesis.

• **A Metallurgical Study of Molybdenum** (PB 111753)—by S. L. Case—Prepared by Battelle Memorial Institute for the Office of Naval Research, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $2.75; 107pp.

In this report, results of a five-year study of the metallurgy of molybdenum are summarized, evaluated and interpreted.

• **Hydrogen Embrittlement and Static Fatigue in High Strength Steel** (PB 121064)—by R. D. Johnson, H. H. Johnson, W. J. Barnett and A. R. Troiano—Prepared by Case University of Technology for Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $1.25; 41pp.

In this report, previous investigations into delayed failure and hydrogen embrittlement in high strength steel under commercial electroplating conditions were extended and the results correlated.

• **Onset of Fast Crack Propagation in High Strength Steel and Aluminum Alloys** (PB 121224)—by G. R. Irwin—Prepared by Naval Research Laboratory, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $.50; 16pp.

In the study, force tendency, a concept of driving force per unit crack front, was applied to fracturing in metals and the results are shown.

• **Thermal-Shock Investigation** (PB 121109)—by T. A. Hunter, L. L. Thomas, and A. R. Bobrowsky—Prepared by the University of Michigan for Wright Air Development Center, and available from OTS, U. S. Department of Commerce, Washington 25, D. C. $2.75; 106pp.

Results of a three-year study of the relative resistance of 14 metals to thermal shocking from the temperature range of 1600F to 2000F are contained in this final report.


NEW - Air-transportable Control Tower

*Flight demonstration at Fort Devens, Mass. of* ***Helicop-Hut*** *Air Traffic Control Set.*

Craig

HELICOP-HUT* AIR TRAFFIC CONTROL SET

*Requires only 30 minutes to set up for operation.*

**A highly mobile two-man unit designed for directing and controlling airport traffic; for Civil Defense and weather reporting purposes.**

**SELF-CONTAINED** (except for primary power), includes communications equipment, weather instruments, console, equipment racks, storage facilities, electrical and ventilating systems, miscellaneous equipment.

**TRANSPORTABLE** by helicopter, cargo aircraft, truck, or special carriage.

**LIGHTWEIGHT** — 2500 pounds complete with electronic equipment.

**COMPACT** — 96" long, 76" wide, 54" high; 75" from floor to ceiling of observation dome.

**SHELTER CONSTRUCTION** — New process—aluminum skins bonded to a plastic foam core give high strength/weight ratio.

*For further information, write or phone —*

Craig SYSTEMS, INC. *TRADE MARK

*Dept. C-11—Danvers, Mass. Phone: Spring 4-1870*

*Craig also supplies other types of control towers, complete mobile electronic systems and various types of shelters, vans and trailers.*

# P&H Welding Positioners give you

# EXTRA CAPACITY

## *for BIGGER PRODUCTION SAVINGS*

**Exclusive P&H design features permit handling greater positioning loads for every dollar you invest**

*Positioned* welding is *downhand* welding, that permits your weldors to use larger, hotter rods for higher deposition rates. This extra welding speed and the savings in handling of weldments cut welding costs as much as 50%.

When economies like this are possible, it pays to get P&H positioners. Size for size, they can handle the widest range of weldments — give you the greatest capacity per dollar invested. The chart below compares the load capacities of positioners in the 3000-lb. class and proves the extra value of P&H.

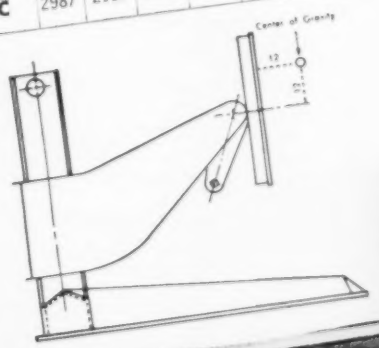
This extra-capacity advantage is found in all sizes of P&H positioners. A free load-capacity table is available to help you select the model best suited to your needs. Just send in the coupon.

**HARNISCHFEGER**
MILWAUKEE 46, WISCONSIN

### 3000-LB. MODELS
### LOAD CAPACITY COMPARISON CHART

Capacity Shown Below at 12" off center of Rotation and Distances of Center of Gravity of Load from Table.

| Positioner | 12" | 18" | 24" | 30" | 36" | 42" | 48" | 54" | 60" |
|---|---|---|---|---|---|---|---|---|---|
| **P&H** | **3000** | **2510** | **2160** | **1900** | **1690** | **1520** | **1390** | **1270** | **1180** |
| **A** | 3000 | 2000 | 1500 | 1200 | 1000 | — | — | — | — |
| **B** | 3000 | 2250 | 1800 | 1500 | — | — | — | — | — |
| **C** | 2987 | 2187 | 1725 | 1424 | 1212 | 1056 | 935 | 839 | 760 |



*I'M SMOOTHARC SCOTTY...and I'm always looking for ways to save money. That's why I like the extra capacity of P&H positioners. Our FREE load-capacity table will show you why.*

SEND COUPON TODAY FOR FREE INFORMATION

**P&H HARNISCHFEGER CORPORATION**
**Welding Division**
4480 West National Avenue, Milwaukee 46, Wisconsin

Attention: W. R. Stephens, Sales Manager

Please send me your free load-capacity table covering the P&H Positioner line.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

3090

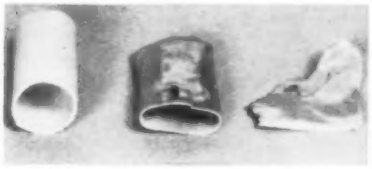
*the* P&H *Line*

P&H welding equipment is manufactured and sold in Canada by REGENT EQUIPMENT MANUFACTURING COMPANY LTD., 455 King Street West • Toronto, Ontario, Canada

# NEW AVIATION PRODUCTS

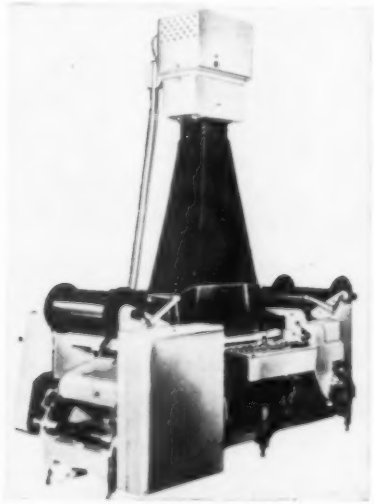
## Irradiated Polymer

Gamma irradiated polymers such as polethylene have increased heat resistance and tensile strength, and reduced cold flow and stress cracking. Electrical insulating properties and chemical inertness remain good. Polyethylene was irradiated by gamma emission from Cobalt 60 source at Stanford Research Center, Menlo Park, Calif. Maker claims "Hyrad" is developed



from this. It is run through high energy beam of electrons. Hyrad can be dipped in molten solder at 600F and remain unaffected. Other polyethylene melts and degrades in 30 seconds. Samples above were exposed to 300F for 96 hours. Sample at left was modified by the new process and irradiated. Center sample was irradiated and right sample was untreated.

**W. R. Grace & Co., 3 Hanover Sq., New York 5, N. Y.**



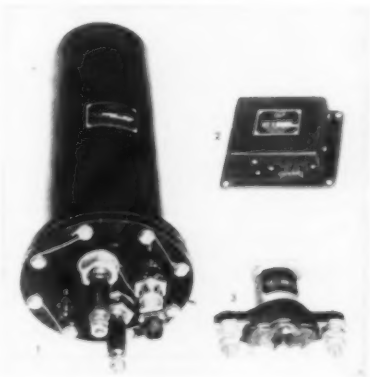
## Electronic Dodger

Photo prints are dodged automatically by type T231 electronic photo printer producing useful results from negatives which would be unprintable using hand dodging. Printer projects brilliant light spot from cathode ray tube. Spot scans negative and print with varying intensity controlled by unit which measures light reaching print and compares this with best possible value. Best effect requires proper scanning pattern, spot size and spectral output. Process is so exact that prints can be made at high speed while in roll form. Need for remakes is eliminated.

**Norden-Ketay Corp., 99 Park Ave., New York, N. Y.**

## Hot Prime Cuts Cold Start Time

Hot fuel prime system for use after cold soak in temperatures as low as −65F makes possible quick starts of reciprocating engines without use of ground pre-heating equipment, insulating blankets or extra manpower. Temperature of fuel in prime tank is raised to 220F in two minutes by electrical resistance heating elements in prime tank walls. Higher temperature makes for better fuel vaporization. Disconnection of heating element makes system usable in warmer climates. It operates on 24 volt source or may be used with 208 volt, three-phase, AC system. In heated fuel starting, primer switch is pushed before starter is energized. Unit may be used on ground equipment. Weight is 10 lb.



**United Aircraft Products, Inc., 116 Bolander Ave., Dayton 1, Ohio**

## Cold Weather Oil Unit

Deaerating cold weather oil system costing an additional 12 lb. per engine replaces tons of hot air carts, ducts and nose hangars, and reduces reciprocating engine warm-up time in arctic temperatures from 3-6-hr. minimums to less than 30 min. System is installed in more than 400 airplanes and helicopters and is in use in many pieces of ground equipment. It segregates diluted oil in hopper circuit from congealed oil in tank, keeping it from being used and fed into tank before heat is available to raise greater part of oil to flow point. Heat exchange through hopper walls helps melt down congealed oil in tank. When oil in hopper circuit

reaches 130F, thermostat controlled diverter valve begins to bleed hot oil into tank. At 160F, tank port is completely open and hopper port is nearly closed.

A small flow through the hopper port is always permitted to prevent the entrance of air with tank oil at the top of the hopper. Diversion of flow through tank deaerates oil and reduces oxidation sludging.

**United Aircraft Products, 1116 Bolander Ave., Dayton 1, Ohio**

## Strobe Shows Shake Specimen

Stroboscope synchronizer permits observer to see part being shake-tested by showing it at any point in the vibration cycle or by reducing the action to slow motion. This cuts time wasted stopping test to observe part. Operator can observe specific mechanical resonances and their effects. Failure can be observed as it develops. Called Model 103A Slip-Sync, it automatically synchronizes strobe lights with vibration exciters regardless of frequency, amplitude or scan rate by controling time-position of flash relative to shake frequency signal. Phase and amplitude of vibration are visible. Slow motion rate

**Peacetime use of atomic energy has become a reality, thanks to the development of the first nuclear reactor designed for private industrial research by Atomics International, a division of North American Aviation.**

**Research Welding congratulates Atomics International on this tremendous achievement and is proud to be a subcontractor to such a forward looking concern.**

**Research Welding's unparalleled skills in metal fabrication of tanks, spheres and components are available for experimental and development work in the construction of missiles, atomic structures and sub-assemblies.**

*Let us analyze your problem. Call or write today for information. New, ultra-modern plant now under construction will provide even greater facilities for the scientific development of your special projects.*

RESEARCH
WELDING & ENGINEERING CO., INC.
10608 SANTA FE AVE. • SOUTH GATE, CALIFORNIA


is continually adjustable from ¼ to 3 cps. by front control panel. Range is from 5 to 10,000 cps.

**Chadwick-Helmuth Co., 472 E. Durate Rd., Monrovia, Calif.**

### Non-Stretch Pressure Seal

Lightweight, non-stretching inflatable seals of nylon reinforced rubber are intended to seal pressurized cockpits, cargo pod junctures and submerged parts of water-borne craft. New seals

are lighter, require less pressure than earlier stretching seals. They also seal and release quicker and more positively. More than two dozen types of American fighters and bombers use canopy seals of this design.

**B. F. Goodrich Aviation Products Division, Akron, Ohio**

## ALSO ON THE MARKET

**Multiple wire thermocouple glands** provide easy entrance into pressure vessels of 1, 2, 4, 6 or 8 wires by Conax method of sealing bare wires at pressures from full vacuum to 20,000 psi. Glands may be used at temperatures ranging from −300F. to +1,850F; range of temperature and pressure is determined by type of sealant used—Neoprene, Teflon or Lava.—Conax Corp., 7811 Sheridan Drive, Buffalo 21, N. Y.

**Model 2E610 electronic cabinet cooling** fan is designed for mounting on a standard 19 in. wide rack with 10½ in. panel height. Item is a twin 6½ in. centrifugal blower with each wheel double inlet; it is equipped with a ½ hp. double shaft motor and produces 800 CFM under normal operating conditions.—McLean Engineering Laboratories, P.O. Box 228, Princeton, N. J.

**Pressure relief valve** in Y, Z, AB, or CD class meets all requirements of MIL-V-5523C (proposed). Units are available in Inline or Tee configuration for immediate delivery or can be supplied in any type housing to meet specific requirements.—Waterman Engineering Co., 725 Custer Ave., Evanston, Ill.

Wanted:

## Design and Development Engineers

HONEYWELL'S many development programs are among the most advanced in the country.

"Human engineering" as explained on the opposite page is only one of the many frontiers being explored in the widely diversified aeronautical control field. Challenging new projects of all types offer a complete range of opportunity.

With many design teams, working on a great variety of projects, we have exceptionally exciting careers ahead for engineers capable of designing components and systems for—

- INERTIAL GUIDANCE
- FLIGHT CONTROL SYSTEMS
- LIQUID MEASUREMENT SYSTEMS
- VERTICAL, RATE AND INTEGRATING GYROS
- DIGITAL COMPUTERS

At Honeywell you'll head up your own task group. Draftsmen, technicians, model makers and evaluation engineers essential to the project will look to you for technical instructions.

An engineering degree or its equivalent plus practical experience with related or similar equipment is required.

**Consider these advantages**

- Minneapolis, the city of lakes and parks, offers you metropolitan living in a suburban atmosphere. No commuting.
- Travel and moving expenses paid.
- First rate salaries, insurance-pension systems, plant and technical facilities.
- Honeywell, leader in control systems, is a sound diversified growth company, continually expanding, that offers permanent opportunity to you.

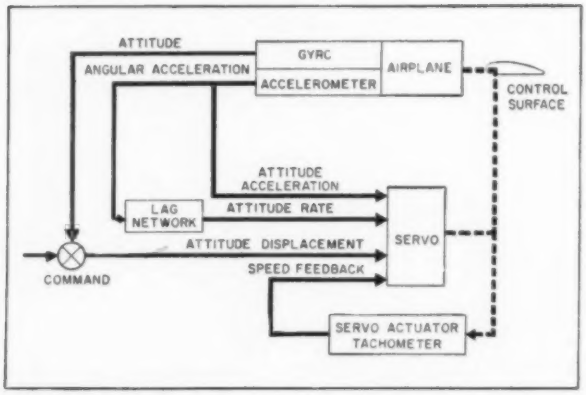
**Write to us**

If you are interested in a career at Honeywell, call or send your résumé to Bruce Wood, Aeronautical Division, 2604 Ridgway Road, Minneapolis 13, Minn.

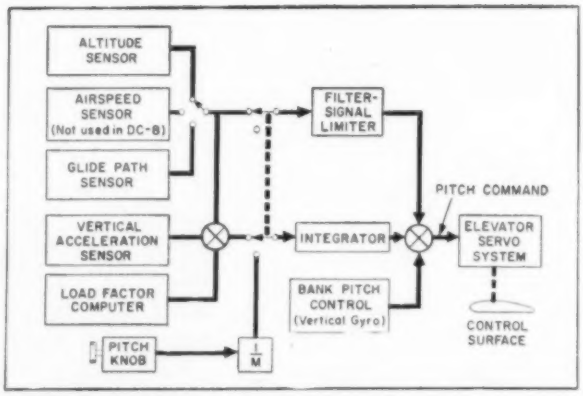
MINNEAPOLIS
**Honeywell**
AERONAUTICAL DIVISION

Which instrument helps the pilot do the right thing the fastest—the one with the moving horizon, or the moving aircraft? Or is there yet a better way? To the pilot flying at supersonic speed, the difference in reaction time is highly critical. This is typical of the "human engineering" problems Honeywell Aero considers in developing advanced control and instrumentation systems for aircraft.

AERONAUTICAL DIVISION, MINNEAPOLIS-HONEYWELL




**SPERRY SP-30** autopilot basic pitch-roll axis servo system.




**ELEVATOR CHANNEL** (pitch axis) block diagram.

# Sperry Innovates Design in Autopilot for

By Philip J. Klass

Sperry Gyroscope Co. has made a break with tradition in the design of its new SP-30 autopilot to meet the more difficult stabilization requirements imposed by the increased speed and altitude range of large jet aircraft.

The SP-30 will be used on the Douglas DC-8 and is a serious contender for several other new jet aircraft.

The use of "inertial stabilization," which substitutes accelerometers for the usual rate gyro and eliminates feedback of control surface position, is only one of many SP-30 innovations.

## Quicker Response

Sperry says the new stabilization techniques will enable the autopilot to respond far more quickly to gusts and changes in airplane configuration, providing tighter control of heading, attitude, altitude and flight path during an automatic approach. The new technique makes the SP-30 equally responsive to disturbances over a wide range of aircraft speeds and altitudes, Sperry says.

The new SP-30 concepts are an outgrowth of Sperry's work in developing automatic flight control systems for the B-47 and B-52—work which has given the company considerable know-how in stabilizing large jet aircraft.

Douglas DC-8 pilots will find all of the automatic assists provided by the older Sperry A-12 and its competitors, plus a few new ones:

• **Altitude control.** Inertial stabilization in combination with a new sensitive barometric altitude sensor is expected to provide a five-fold improvement over the A-12 in accuracy of holding altitude and in prevention of porpoising, according to George Jude, director of Sperry's flight control engineering department. This estimate is based on simulator studies and limited flight tests to date.

• **Automatic approach.** If the pilot so desires, he need only head the DC-8 to intersect the ILS localizer and the SP-30 will carry on automatically from there.

The autopilot will turn the airplane onto the localizer and "capture" the beam. Automatically the autopilot will switch to tighter localizer control, switch off altitude control when the glide slope is intersected and then head down the beam. The SP-30 automatically compensates for steady crosswinds.

• **Heading selection.** This is a fairly recent autopilot addition which enables the pilot to select any desired new heading and causes the autopilot to maneuver the airplane smoothly onto the selected heading.

• **Yaw damping.** A new feature for civil autopilots, but old hat on military jets, is the use of the rudder channel to provide automatic stability augmentation both in manual and automatic flight.

DC-8 pilots will find that the yaw damper also provides automatic ball-centered turn coordination without any human rudder pedal action.

## New Controller

Pilots will find a new look in the appearance of the SP-30 console controller—the device used to select operating modes and to introduce airplane maneuvers through the autopilot (see photo, p. 77). But the most significant difference is not apparent to the eye.

In the older A-12, rotation of the controller pitch wheel produced a proportional change in airplane pitch attitude. In the new SP-30 controller, pitch maneuvers are introduced by means of a spring-loaded (self-centering) toggle-switch type of control. Displacement of this pitch control from center produces a rate-of-change of airplane pitch attitude proportional to control displacement.

To prevent the possibility of the pilot inadvertently actuating the pitch or turn control knobs and introducing sudden maneuvers, these controller signals are not introduced directly into the main control surface servo circuits. Instead they operate small servo motors called command computers, which generate duplicate signals that operate the control surface servo actuator. This provides a buffer between the pilot's controller and the airplane control surfaces.

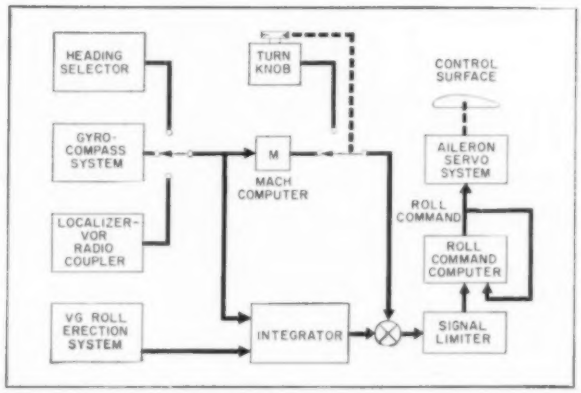
To permit smooth, precise maneuvers over the full airplane speed range, the signal sensitivity of the SP-30 pitch maneuvering control is automatically decreased as speed of the airplane increases.

## Safety Features

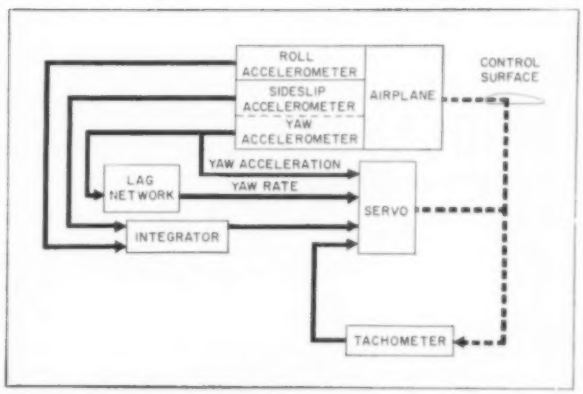
Sperry has incorporated a number of other design features aimed at improving the reliability and safety of the SP-30 automatic flight control system. These include:

• **Three-axis malfunction protection.** Automatic monitoring control is designed to detect system failures that might cause sudden control surface deflection, then disconnect the autopilot. The system, which uses paired accelerometers and other components, can also detect failures in gyros or other sensing elements, according to P. Halpert, chief engineer of Sperry's Aeronautical Equipment Division.

• **No vacuum tubes.** Sperry has used




**AILERON** channel (roll axis) block diagram.




**RUDDER** channel (yaw axis) block diagram.

# Jet Transport

transistors, diodes and magnetic amplifiers throughout, thereby eliminating all vacuum tubes in the SP-30.

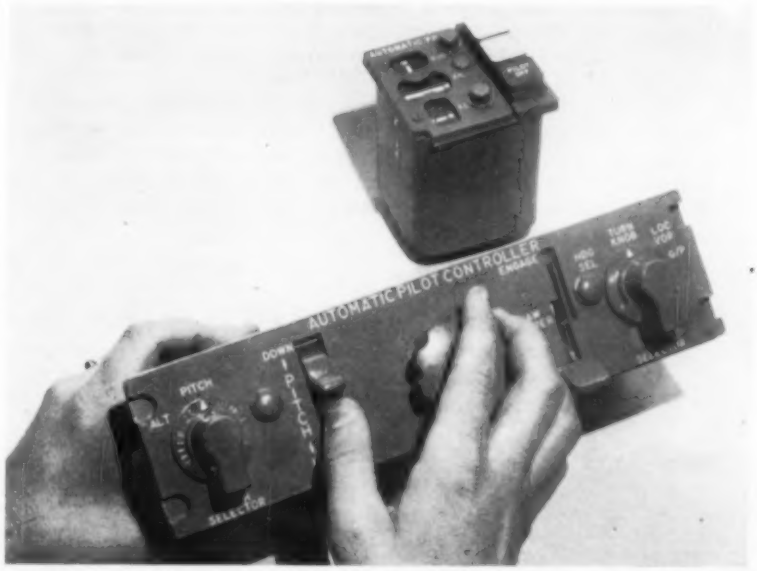
• **Redundant circuitry.** As a further hedge against serious malfunctions, Sperry has designed its three main servo amplifiers (which power the control surface actuators) with duplicate components and circuitry. The two transistor pre-amplifiers and the two mag-amp output stages are cross-connected in a matrix so that most types of failures will not incapacitate the whole amplifier. For example, failure of one transistor pre-amp drops overall amplifier gain by only 20%. If one of the mag-amp output stages should fail, the servo actuator can still deliver up to 50% of its normal maximum force and there is no loss of amplifier gain or shift of null, Sperry says.

• **Maneuver limiter.** SP-30 pitch and roll channels each contain circuits which can be set to limit the maximum pitch or bank angle signal which can get through to the servo amplifiers, thereby limiting maximum airplane pitch and bank angles. During an automatic approach, the maximum possible bank angle is reduced automatically after the localizer beam has been captured.

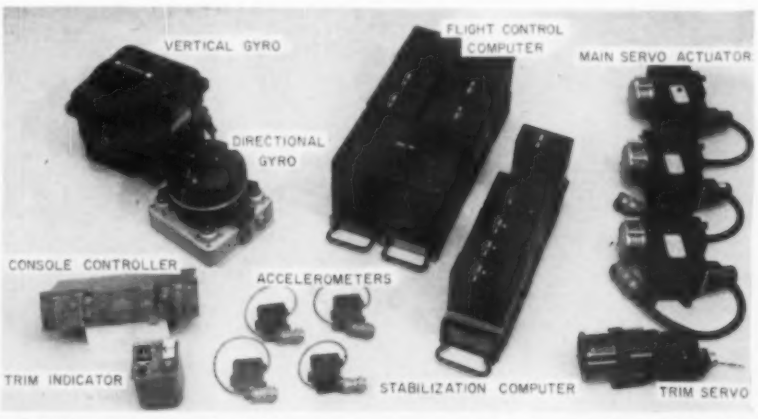
## Stabilization Techniques

Until the latter part of World War II, automatic pilots largely used displacement type control systems. The autopilot gyro measured any displacement of the airplane from a desired attitude or heading, then deflected the control surface by an amount and at a speed proportional to this airplane displacement.

With the advent of higher speed aircraft with less inherent stability, autopilot designers found that the re-




**CONSOLE** controller, used by pilot to introduce airplane maneuvers through autopilot, has novel type pitch axis control. Behind is control surface trim indicator.




**SPERRY SP-30** automatic flight control system uses no vacuum tubes, weighs about 30 percent less than its A-12 predecessor, despite additional operating features.

# EXTRUSIONS FOR TOMORROW
*from*
# BRIDGEPORT ALUMINUM TODAY

*tested to their limit...*
*to assure long, vital life*

As increasing new demands are placed on aircraft, every structural part has to do more work—and do it better. To meet these demands, engineers are calling on Bridgeport Aluminum Extrusions to meet specifications and assure long, vital life.

Every Bridgeport Aluminum Extrusion for aircraft use can be ultrasonically tested before it is shipped. Its prototype has been worked to its limit. Then, too, there are Brinell hardness tests, sectional tests to determine grain structure and scores of inspections at every manufacturing step.

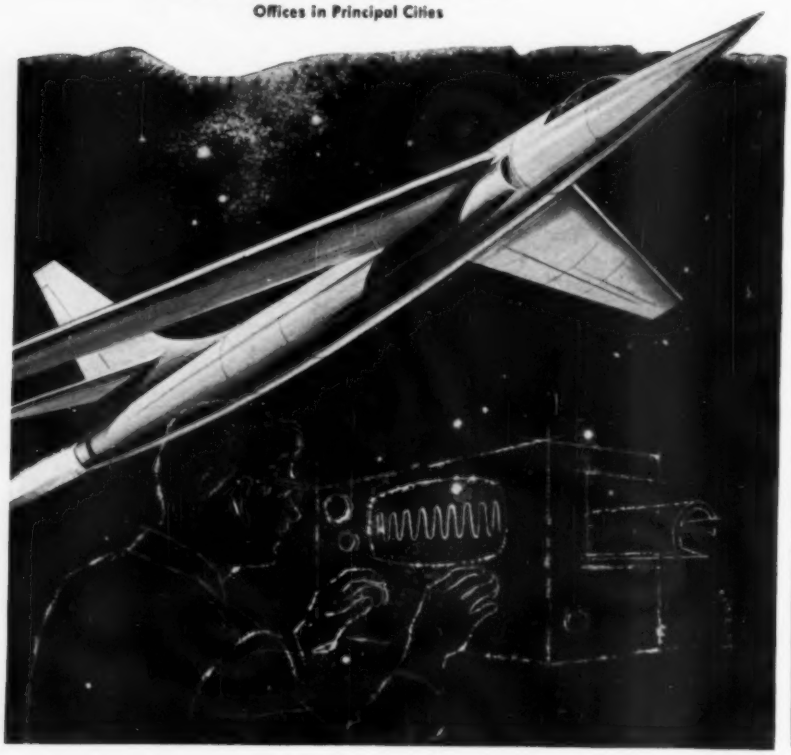
High-strength precision shapes, free from hidden defects, are the result of Bridgeport's thoroughness. What's more, Bridgeport's facilities can produce a range of shapes to serve tomorrow's aviation horizons. Details about our services, equipment and our alloys are readily available from the nearest Bridgeport Sales Office. Why not call them today?

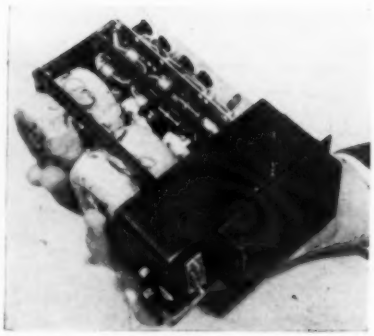
For the very newest in
**BRIDGEPORT ALUMINUM**
Bridgeport Brass Co.

**Aluminum Extrusion and Forging Facilities at Adrian, Mich.**

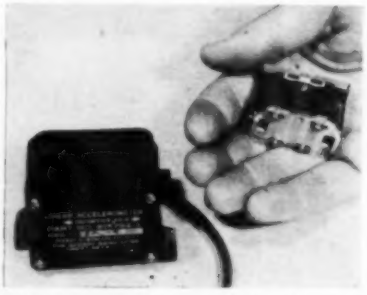
**Bridgeport Brass Company, Bridgeport 2, Conn.**

**Offices in Principal Cities**



**MAIN** servo amplifier uses transistors, magnetic amplifiers plus circuit redundancy to provide increased reliability.



**LINEAR** accelerometer, used in pairs, measures airplane angular acceleration.

sponse and performance of a displacement type autopilot was not adequate. This led to the addition of a rate signal which caused the autopilot to deflect the control surface proportional to both the magnitude and the rate of airplane displacement. For example, if the airplane were changing attitude rapidly, the autopilot would deflect the control surface faster and farther than for a slow change in airplane attitude.

In some autopilots, notably the Sperry A-12 and the Lear F-5, this rate signal is obtained by taking the first derivative of the gyro displacement signal.

In more recent military autopilots, and in the new Eclipse-Pioneer PB-20, designers have used rate gyros to obtain this rate signal.

### Inertial Stabilization

Sperry has now added a full second derivative signal—airplane angular acceleration.

This signal is obtained from a pair of electrically-connected linear accelerometers, mounted five or more feet apart, which together perform as an angular acceleration sensor. One of the two accelerometers used to measure pitch axis acceleration is mounted near the airplane center of gravity, while the other is installed in the nose. The yaw axis accelerometers are similarly located, while the roll axis accelero-

# to err is human . . .

## . . . but very costly

Replacing a blown fuse with one of the wrong rating is common . . . often the natural thing to do when the correctly rated fuse is not at hand.

This mistake, whether it is in error or an expedient means of putting the protected equipment back in service, is costly. It accounts for poor product reputations and costly service expense to manufacturers.

There is no margin for error when your equipment incorporates HEINEMANN CIRCUIT BREAKERS. The correct rating is built right into your product. Once fault conditions have been corrected, service is restored instantly and easily with just a flick of the circuit breaker handle. No replacement necessary.

And, since HEINEMANN CIRCUIT BREAKERS serve as a power switch, too, overall costs of a circuit breaker and comparable fuse installation are quite close.

Send for your copy of the CIRCUIT BREAKER ENGINEERING Guide, just ask for Bulletin 201.

Heinemann General Purpose Three-Pole Circuit Breaker. Available in odd or fractional ratings from 0.010 to 70 amperes. (Other models to 100 amperes.) Ratings are not affected by ambient temperature.

**HEINEMANN**
**ELECTRIC COMPANY**
158 Plum Street, Trenton 2, N. J.

*Circuit breakers*

# -the heat's off!

This Electronic Reliability Engineer just discovered the IERC way to insure his chances of meeting equipment reliability specifications and military acceptance schedules.

Tubes failures (too often and too soon) caused by heat and vibration, *the major causes of electron tube failures,* were his problem.

With IERC Heat-dissipating Tube Shields, the "heat was off" *both* the suffering tubes and our man with the problem! Tube operating temperatures were lowered as much as 150°C and tubes are lasting 5 times longer. Schedules were met—time and money saved—highest tube reliability achieved!

*Suspect and investigate the heat and vibration menace when tube failures plague you. Eliminate it with IERC Heat-dissipating Tube Shields —available in sizes for Miniature, Subminiature, Octal and Power types of electron tubes.*

PATENTED OR PAT'S PEND. IERC T-12 SHIELD AND BASE WITH 6080 TUBE ILLUSTRATED.
CROSS-LICENSED WITH NORTH AMERICAN AVIATION, INC.

**IERC literature and latest Octal and Power tube shield Technical Bulletin available now—FREE!**

**International electronic research corporation**

145 West Magnolia Boulevard, Burbank, Calif.

meters are both mounted near the c.g., but separated in the vertical plane.

In addition to using this airplane angular acceleration signal directly, Sperry also integrates it (in a lag network) to provide a rate signal, thereby eliminating the need for separate rate gyros. The airplane displacement signal is obtained in conventional fashion from vertical and directional gyros.

Examination of the block diagram (p. 76) for the basic servo systems used in the pitch and roll axes reveals that there is no position feedback from the control surface—a rather surprising omission in airline-type autopilots. (There is, however, a tach generator feedback from the servo actuator to permit use of high gain servo amplifiers.)

### Speedy Response

Any displacement of the airplane produces gyro and accelerometer signals which call for corrective control surface deflection. Such deflection does not produce any opposing signal (as in conventional autopilots) until the airplane itself begins to respond. When this happens, the angular accelerometer generates a signal which opposes the original gyro signal, slowing down the rate of control surface deflection and eventually reversing it.

Without the constraint of a displacement feedback signal from the control surface, the autopilot is able to apply its corrective action more rapidly. Nonlinearities in the airplane control system or boost valves, which can cause serious stability problems in an autopilot using position feedback, are not a problem in the SP-30, according to R. H. Wagner, head of Sperry's transport flight control engineering department.

A conventional autopilot, whose control surface deflection is proportional to airplane displacement and rate, may encounter stability problems in wide speed range aircraft because the control moment produced by a given control surface deflection varies with airplane speed. To meet this problem, new military jet autopilots have added automatic gain changers which vary system performance as a function of airplane speed.

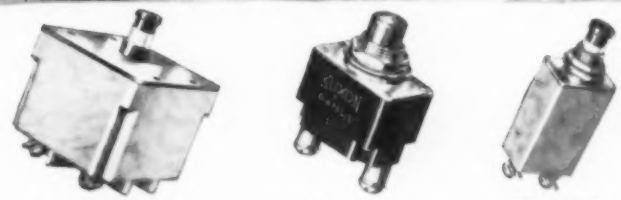
### Control Moment

The Sperry SP-30 needs no gain changer for this purpose because a given airplane displacement produces essentially a proportional control moment (angular acceleration) rather than a proportional control surface deflection, Wagner points out.

The Sperry inertial stabilization techniques provide a solution to another problem encountered in jet aircraft—finding a good source of static air for operating the autopilot altitude sensor. Under changing airplane attitudes or configurations, the static source may

Yesterday
In 1939 the KLIXON NAF-1131 was the first circuit breaker ever developed for use in U. S. aircraft electrical systems. Other KLIXON designs were firsts and became equally famous in military applications of all kinds.
KLIXON PM Manual Reset. The Original Aircraft Circuit Breaker.

Today
KLIXON circuit breakers enjoy a well-earned reputation for outstanding performance in design and operation . . . in military and commercial planes, at home and abroad — wherever there are circuits to protect.



Tomorrow
Our ceaseless engineering program promises even better circuit breakers, keeping pace with progress in aircraft electrical system design. Write for technical bulletins today.
In circuit protection you can count on
KLIXON
METALS & CONTROLS CORPORATION
SPENCER THERMOSTAT DIVISION
2811 FOREST STREET, ATTLEBORO, MASS.

There's Plenty of SPA* at AIRWORK (IN MIAMI)

THIS BASE IS A MAJOR SUPPLIER TO THE AIRLINES... AS WELL AS BUSINESS AVIATION. FACTORY-NEW SPARE PARTS FROM MOST LEADING MANUFACTURERS OF ENGINES AND ACCESSORIES ARE STOCKED HERE.

Phone Jerry Church or Bob Fleury at TUxedo 8-3467 for next truck deliveries. Or Write P.O. Box 194, Miami, Florida.

*Spare Parts Availability

Airwork CORPORATION

ALEXANDRIA • CLEVELAND
ATLANTA • MIAMI • NEWARK

indicate a loss of altitude momentarily when the airplane has actually gained altitude, or vice versa. The human pilot can be told to disregard this momentary reverse-sense indication but it badly confuses the automatic altitude control of a conventional autopilot.

To get around this problem, the SP-30 derives a rate-of-change of vertical position signal from one of the accelerometers located at the airplane c.g. by integrating its output signal. This inertially derived rate-of-change signal, without the lags characteristic of a bellows-type sensor, provides the initial intelligence to the SP-30 that the airplane has changed altitude.

A servo-powered bellows type altitude sensor, whose output is filtered to take out reverse-sense transients, provides a displacement signal. The signal also is integrated, by means of a motor-driven integrator, thereby providing a displacement, integral, and rate signal for use in maintaining the airplane at a constant altitude. (The integrator also functions to compensate for aircraft pitch trim changes.)

During a turn, the increased vertical acceleration measured by the accelerometer would appear to the SP-30 as a change of altitude when such was not the case. To prevent this, a load factor computer produces a signal proportional to bank angle when the airplane is in a turn which cancels out the signal developed by the accelerometer during a turn.

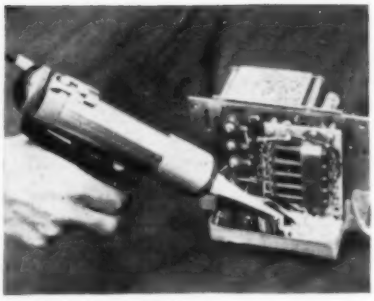
The same type of circuitry used for altitude control is employed in the pitch channel during an automatic approach to produce greater stability during the final phase of an ILS approach, according to Wagner. The use of inertial damping should permit automatic approaches to lower altitudes without the familiar oscillation that takes place as the beam narrows, Wagner concludes on the basis of simulator studies and flight tests in a B-26, and DC-3.

The use of a rate-of-change of airplane vertical position, obtained by integrating the output of the vertical accelerometer, makes the SP-30 resist any tendency of the airplane to deviate from the glide slope. This signal is supplemented by the conventional beam displacement signal from the glide slope receiver, suitably filtered to eliminate transients, plus the integral of beam displacement.

### Turn Control

The SP-30 follows the practice of recent military jet autopilots of introducing heading changes through the aileron channel instead of through the rudder channel. (See block diagram, p. 77.) Signals from the gyro compass system, heading selector, or ILS localizer/VOR radio coupler are introduced into the aileron channel as both displacement and integral of displacement. A Mach computer serves to vary automatically the relationship between heading error and the bank angle signal introduced into the aileron channel servo amplifier. The higher the airplane speed, the greater the bank angle signal produced for a giving heading error.

During an automatic approach the SP-30 cuts itself free from a magnetic heading reference. This allows the air-



## Cushion

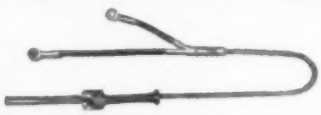
**New silicone rubber that cures at room temperature is used by Northrop Aircraft to cushion its avionic equipment against shock and vibration and to keep out moisture. New Silastic RTV, applied with air gun, can be slit open after curing to permit replacement of components, then patched over with more silicone rubber.**

STURDY, FAST ACTING RESISTANCE BULBS BY LEWIS

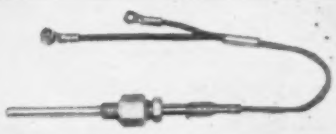
FREE AIR TYPE, MS28038-1 to MIL-B-8598

THREADED, PROBE TYPE MS28034-1 and MS28034-2 to MIL-B-7990

CYLINDER HEAD, BAYONET TYPE AN5546-1 to MIL-B-5491



PROBE TYPE, WITH ADJUSTABLE STAINLESS STEEL STUFFING-GLAND



FOR DEPENDABLE TEMPERATURE MEASUREMENTS, USE LEWIS BULBS WITH LEWIS RESISTANCE THERMOMETERS.

the LEWIS ENGINEERING COMPANY
naugatuck, connecticut

plane to weather vane into any existing crosswind at whatever crab angle is needed to keep the airplane on localizer beam center. The motor-driven integrator enables the autopilot to compensate for persistent errors in localizer control, such as sharp changes in crosswinds during an instrument approach.

### High Speed Problem

Northerly turning errors encountered in simple magnetic compasses become a problem at the jetliner speeds. If the airplane should drop a wing slowly, putting it into a mild turn, the gyro compass heading control might be expected to detect the change in heading and level the wings.

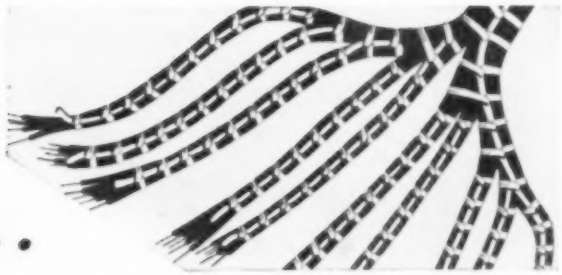
However, if the airplane is headed in a northerly direction, the compass sensor aligns to a false north, precessing the directional gyro in the same direction in which the airplane is turning so that the autopilot does not detect any change of heading or take corrective action.

Although the vertical gyro erection system automatically cuts off when the bank angle is 5-7 deg. (or a maneuver is introduced from the controller), slow turn is not sufficient to cut the gyro free of its erection system. Hence the centrifugal forces generated by the turn will precess the gyro to a false vertical in such a direction as to cause the autopilot to increase the airplane bank angle and rate of turn further.

To counteract this phenomenon, the spurious vertical signal from the liquid level accelerometer mounted on the

## New Storage Drum

Novel computer magnetic storage drum has 64 channels but requires only two pick-off heads instead of the 64 normally needed. The Northrop Aircraft development mounts the two pick-off heads on a carriage which moves the length of the drum in one second. Drum has a 2,000 word capacity and rotates at 1,800 rpm. New design greatly reduces channel switching circuitry complexity and overall computer size, provides greater reliability, Northrop says.

NEW...

TEFLON-GLASS FIBER LACING TAPE

New Ben-Har Braided Lacing and Winding Tape combines two superior insulation materials—DuPont Teflon and glass fibers. Fibers are Teflon coated before braiding to maintain rough texture and assure tight knots—and to eliminate abrasive action of the glass. Ben-Har Tapes will not shrink and cut through insulated wires. They are pliable from −100°F. to 500°F. They are non-absorbent and inert to most known chemicals and oils . . . completely wax-free and fungus proof.

Available in 3/64, 1/16, 3/32 and 1/4 inch widths, in Offwhite. Also available in 8 colors and Black on special order. Write for prices and samples.

BENTLEY, HARRIS MANUFACTURING CO.
2111 Barclay St. Conshohocken, Pa.

BENTLEY, HARRIS Fiberglas* INSULATIONS

*T.M. Owens-Corning

JUST ARRIVED

IN CLEVELAND
(AT AIRWORK, OF COURSE)

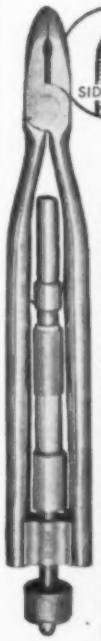
SPA ELIMINATES LOST TIME FROM SPARE PARTS DELIVERIES. YOU GET OFF-THE-SHELF DELIVERIES OF SPARE PARTS FROM MORE THAN A DOZEN MANUFACTURERS, INCLUDING ALL THE BEST KNOWN NAMES IN ENGINES AND ACCESSORIES.

Just call Orchard 1-0522 and ask for Bob Scott or Boyd Gillen. Or write: Building No. 8, Cleveland Hopkins Airport, Cleveland 11, Ohio.

*SPA means Spare Parts Availability

Airwork CORPORATION
ALEXANDRIA • CLEVELAND
ATLANTA • MIAMI • NEWARK

Now!... the NEW ROBINSON WIRE TWISTER with DIAGONAL GRIP-HEAD




Faster, more efficient than ever! The new, slendernose DIAGONAL GRIP-HEAD is designed especially for those narrow- hard-to-reach places. Split-second whirling action safety-wires 3 engines in time required for one by any other method . . saves as much as $140 per engine assembled.

3-TOOLS-IN-1 . . pliers-cutters-twisters. Side-cutting, oil-tempered head. Permanent bronze bearing. No adjustments. Jaws lock on wire, can't slip off. Perfect, uniform twist every time.

12" —for assembly line safety wiring, 15 oz. $21.50
9" —for bench work, sub-assemblies, 12 oz. $20.50

Unconditional Money-Back Guarantee. Send for complete details.

RALPH C. ROBINSON CO.
Box 494W No. Sacramento 15, Calif.

Canadian Distributor, Gensales, Ltd., Malton, Ont.

# All business is specialized

*. . . and nothing specializes on <u>your</u> business like your business paper*

Here's a smart business man. He spends his time where every sitzmark parks a prospect at his feet. It's simple sense: He *specializes* . . . and it *pays*!

Your business is specialized, too . . . and so is your business paper. The time you spend with it pays . . . for its editors are experts in your specialty. They scout the field . . . report what's good that's new . . . find ideas that worked . . . suggest methods to keep you a leap ahead of competition.

The ad pages are as specialized as the editing. They, too, tend strictly to business . . . your business. They bring you data on new products, new materials . . . gather in one place a raft of ideas on where-to-buy-what, or how to make (or save) a dollar.

That's help you can't find concentrated into such quick reading time *anywhere* else! It's help that puts many a man out front in his field, as a specialist who knows what's what today . . . sees what's coming tomorrow. It's simple sense to read every page, every issue.

---

This business paper in your hand has a plus for you, because it's a member of the Associated Business Publications. It's a paid circulation paper that must earn its readership by its quality . . . And it's one of a leadership group of business papers that work together to add new values, new usefulness, new ways to make the time you give to your business paper still more profitable time.

**A copy of this quick-reading, 8-page booklet is yours for the asking. It contains many facts on the benefits derived from your business paper and tips on how to read more profitably. Write for the "WHY and HOW booklet." Room 2710.**

**McGRAW-HILL PUBLISHING COMPANY**
**330 West 42nd St., New York 36, N. Y.**

One of a series of advertisements prepared by THE ASSOCIATED BUSINESS PUBLICATIONS

vertical gyro, which is used to sense the apparent direction of gravity is fed into the roll channel integrator. This spurious vertical signal is integrated, to match the integration that takes places in the gyro precessing action, and introduced into the roll axis. This deflects the ailerons until the erection sensor signal is zero, thereby leveling the wings and eliminating the slow turn. The same circuit functions similarly to eliminate the effects of accelerations produced by gusts, Jude says.

### Rudder Channel

SP-30 stability augmentation is obtained by using a yaw angular acceleration signal, and its integral (rate of yaw) to produce corrective rudder action. When the airplane is banked, either manually or through the autopilot, a signal developed by the roll angular accelerometer is integrated to produce a rudder displacement proportional to the airplane's rate of roll. Once the airplane is in a turn, a signal from one of the pair of yaw angular accelerometers senses sideslip. This signal is integrated and used to hold whatever rudder deflection is required to provide a ball-centered turn.

For safety reasons the Civil Aeronautics Administration requires that maximum autopilot servo force be limited to a value which can not produce more than a one G mancuvering load on the airplane under the most adverse flight speed or configuration. While this is a laudable objective, it results in a servo whose maximum torque can only pull a fraction of one G at other airspeeds and configurations thereby limiting the autopilot's effectiveness.

### Servo Torque

The SP-30 has a novel arrangement which makes it possible to match maximum servo torque to the airplane's needs and vary this maximum with airplane speed. Equally important, from a stabilization standpoint, maximum servo torque is varied in a manner which does not change overall system gain, according to Wagner.

This is accomplished by changing the level of excitation in the magnetic output stages of the servo amplifiers automatically as a function of airplane speed.

The SP-30 installation for the DC-8 will use electrical motor-driven servos, although hydraulic actuators can be provided. The motors are d.c. split field series type. The entire servo weighs only 10 lb., about half the weight of its A-12 predecessor. Engaging and disengaging the servo and its output pulley are accomplished electrically by means of a solenoid operated clutch.

To minimize the possibility of the clutch jamming and preventing disengagement, Sperry uses a clutch design


The *New* Pastushin Full-Shear Stress Panel Fastener does what a panel fastener should do!

- absolute positive lock... full shear strength
- automatic spring ejection of stud... no prying to free panel
- curved panel is no problem
- only two assemblies (self-retained)... stud and retainer
- no special installation tools... Phillips head recess

PATENT PENDING

*Available now in quantity!*

*Fastens and unfastens a panel faster and easier than any other fastener on the market!*

**Check these important features:**

**Full Shear Strength**... stud design transmits full shear strength equal to NAS-547 specification, and/or NAS 334-335 close tolerance bolt.

**Positive Mechanical Lock**... when stud is seated, it's locked! Visual inspection assures safe lock.

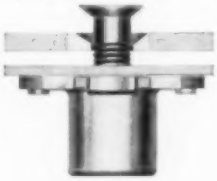
**Automatic Stud Ejection**... when stud is released, it is automatically spring-ejected from the retainer, allowing panel removal without forcing or prying.

**Curved Panels** offer no problem...small radius of entry of stud into retainer assembly allows installation and operation on surfaces of less than one inch radius.

**Double Lead Stud Thread**... assures top performance and trouble-free long service life.

**Materials and Finishes**... critical bearing surfaces are of CM steel, heat treated to rigid specifications. Steel parts are cadmium plated, aluminum alloy parts anodized.

This is the actual size of the ¼" fastener assembly ... tiny, lightweight and strong. The 5/16" unit is proportionately larger.



*Write for complete information on Pastushin's Full-Shear Stress Panel Fasteners, designed for high-strength and simplified securing of access panels and equipment on modern aircraft.*

**PASTUSHIN INDUSTRIES, INC.**

5651 WEST CENTURY BOULEVARD, LOS ANGELES, CALIFORNIA

*Affiliate Companies*

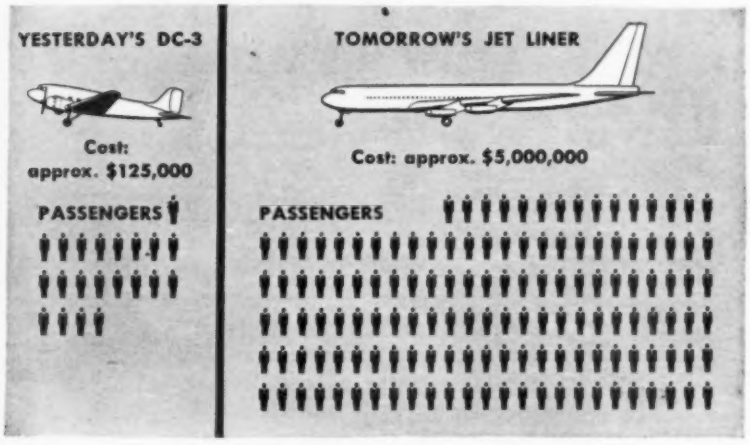
**PASTUSHIN AVIATION CORP.** Los Angeles, California | **HAWAIIAN AIRMOTIVE, LTD.** Honolulu, Hawaii

DEVELOPERS AND MANUFACTURERS OF AIRCRAFT FASTENERS

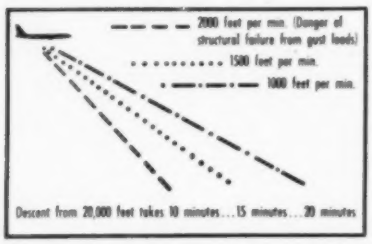
# Is your present safety program BIG ENOUGH for tomorrow's airliners?

*Compare your equipment . . . your passenger volume . . . your cost and risks of doing business today with 15 years ago. And tomorrow, the stakes will be even higher.*

**COMPARE YOUR INCREASE IN CAPITAL INVESTMENT AND RISK**




*Skydrol protects your capital investment and lessens your liability risks.*


2000 feet per min. (Danger of structural failure from gust loads)
1500 feet per min.
1000 feet per min.
Descent from 20,000 feet takes 10 minutes... 15 minutes... 20 minutes

The chart above proves what many pilots already know: To descend and land from high altitude takes so much time that fires in flight can be critically dangerous! You can lessen the possibility of these fires simply by replacing flammable hydraulic fluid with fire-resistant Skydrol . . . the world's only fire-resistant hydraulic fluid approved by the C.A.A. 4½ million flying hours' experience have proved Skydrol a better lubricant than mineral oil . . . extremely stable . . . can be re-used again and again and won't corrode metal. Conversion to Skydrol costs less than you think! For more information, write . . . *Organic Chemicals Division*, MONSANTO CHEMICAL CO., Dept. SKD-3, St. Louis 1, Missouri.

**34 MAJOR AIRLINES NOW USING SKYDROL**

| | | | |
|---|---|---|---|
| American | National | Delta | LAI |
| Braniff | Northeast | Slick | ANA |
| Continental | Panagra | JAL | Aramco |
| Flying Tiger | Western | PAL | U.S.A.F. |
| Pan American | Aigle Azur | CMA | B.O.A.C. |
| Canadian Pacific | Cathay Pacific | KLM | Northwest |
| North American Aircoach | Alitalia | LAN | Airwork, Ltd. |
| | Swissair | TAI | Lasca |
| Trans-Caribbean | United | UAT | |

*Skydrol: Reg. U. S. Pat. Off.*

**MONSANTO CHEMICAL COMPANY • ST. LOUIS, MISSOURI**

*Where Creative Chemistry Works Wonders For You*


which engages and disengages by flexing rather than by sliding action. If the clutch should jam, the pilot can slip the clutch gear against its wide angle teeth by applying 150-200% of normal maximum servo torque on his control column.

If this should fail, the pilot can exert more force and drive back through the motor to operate the control surface manually.

To permit frequent field checks on maximum servo torque, Sperry has included provision for inserting a torque measuring device in the servo without removing it from the airplane.

## New Facility Offers Computer Services

**El Segundo, Calif.**—New analog computer facility specifically established to serve West Coast industry has been opened here by Electronic Associates, Inc.

Equipment of the facility, known as the EAI Computation Center, will be available on an hourly rental basis.

Housed in a new 5,000 sq. ft. building, the facility is fitted with two complete analog computer systems, five electronic multipliers, and a 30 x 30-in. two-pen plotting board. Hourly rental charges are $45 for each computer, $8 for the multiplier rack, and $5.25 for the plotter. Rental of both computers will include use of the plotter at no extra cost.

A staff of applications engineers is available for problem set-up and computer operation, at the hourly rate of $15.

Six private engineering offices are available for customer use for problem preparational and data reduction phases.

The center offers these options:

- **Customer can operate** the computer with his own personnel.
- **Customer can utilize** EAI engineering personnel to assist in programming and solving the problem on the computer.
- **EAI will take** customer's problem and handle the solution. This service is limited and depends on the type of problem and the EAI staff available for its solution.

Time on the center's computers is booked almost through January. Users include Radioplane Co., Hughes Aircraft Co., Ramo-Wooldridge Corp., and Atomics International Division of North American Aviation, Inc. Rheem Mfg. Co. also has used the facilities.

In its expansion program, EAI is opening another analog computing center in Brussels, Belgium, within the next six months.

The computation center which EAI opened in Princeton, N. J., in 1954, to serve industry on a rental basis, is still in operation.

# Expansions, Changes In Avionics Industry

Minneapolis-Honeywell has purchased Davies Laboratories, Beltsville, Md., maker of high speed data recording systems using magnetic tape. New acquisition will be headed by Gomer L. Davies, founder, under the direction of H. F. Dever, M-H vice president and head of its Industrial Division. Davies Laboratories will remain at its present location.

Other recently announced avionics industry expansions and changes include:

• **Philco Corp.** has purchased Sierra Electronic Corp., San Carlos, Calif., a research and instrument manufacturing firm. New acquisition will be operated as a wholly owned subsidiary under its former president, Willard Feldscher, as vice president and general manager. Philco says it plans to expand Sierra's present efforts and technical manpower.

• **Hoffman Laboratories, Inc.,** Los Angeles, will build a new 40,000 sq. ft. research and development facility opposite present Hoffman Laboratories building on South Grand Ave. Company also has broken ground for new 10,000 sq. ft. building to house its administrative offices.

• **Communications Accessories Co.,** Hickman Mills, Mo., maker of toroidal components and magnetic amplifiers will move in February to new 57,000 sq. ft. building in Lee's Summit, another suburb of Kansas City, Mo. The firm is a subsidiary of Collins Radio.

## FILTER CENTER

▶ **New USAF Reliability Group**—Air Materiel Command will form new Communications-Electronics Reliability Committee, supported by the Air Research and Development Command, to find contract policy improvements which will increase avionic manufacturers' reliability responsibilities. The program is in line with policy laid down by Defense Department's Advisory Group for Reliability in Electronic Equipment (AGREE) (AW Mar. 12, p. 249). New group also will seek to include reliability evaluations in both R&D and production contracts and to find methods to improve maintenance field failure reporting.

▶ **New Tube Filament Material**—Battelle Institute has started two-year program to learn more about rhenium and its possible use in vacuum tube filaments in place of tungsten. Rhenium, a "scarce" metal, costs nearly as much as platinum at present. However it exhibits good ductility after temperature cycling in sharp contrast to the brittleness of tungsten. Program is sponsored by Air Force Cambridge Research Center.

▶ **Meteor and Aurora Scatter Study**—Stanford Research Institute will study VHF and UHF signal reflections from meteor trails and ionization associated with the Aurora Borealis under Rome Air Development Center sponsorship. SRI's research at frequencies of 100 to

## 'Little Sage'

**USAF's first automatic ground control intercept system for air defense, the AN/GPA-37, operates from radar data and automatically computes intercept path, transmitting GCI commands directly to the interceptor's automatic fire control system through a radio data link. Although not as fully automatic or sophisticated as the SAGE system (AW Jan. 30, p. 46) the AN/GPA-37 is now in use by Air Defense Command. It was developed by Columbia University, re-engineered and produced by General Electric's Heavy Military Electronic Equipment Dept. under Rome Air Development Center sponsorship.**


Here's the **SMALLEST and LIGHTEST**

Quick Disconnect in the Air...!

*New* MARK II SPEED-RIG

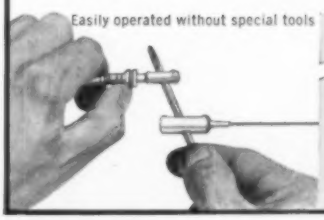
TRADE MARK

CONTROL CABLE is quickly disconnected with the new Mark II Speed Rig...and can be restored to identical tension in a matter of seconds—*without re-rigging!*

Ideal for use where space and weight are critical, the miniature Mark II is available for swaging directly to a cable, or can be furnished with a threaded end to replace any existing standard turnbuckle.

All the advantages and convenience of a quick disconnect *and* a turnbuckle are now available *for virtually the same weight as a standard turnbuckle alone!*

For greater design freedom, easier maintenance and faster inspection, the Speed Rig is indispensable. Write today for Pacific's new bulletin on Control Cable Quick Disconnects—no obligation, of course!




Pacific PACIFIC SCIENTIFIC COMPANY

P. O. BOX 22019, LOS ANGELES, CALIFORNIA

San Francisco • Seattle • Arlington, Texas • San Diego

REPRESENTATIVES: AERO ENGINEERING CO., Atlanta, Ga. • Baltimore, Md. • Indianapolis, Ind. • Mineola, L.I., N.Y. • Columbus, Ohio • St. Louis, Mo. • GARRETT MFG. CORP., Toronto, Canada. In England: TELEFLEX PROD., LTD. In France: SARNA—St. Vallier

*Because only the best is good enough . . .*

**First Choice in**

**OXYGEN EQUIPMENT**

**is Bendix . . . built by**

**Pioneer-Central**

Oxygen equipment to keep pace with ever higher operational ceilings is essential.

Bendix Oxygen Equipment . . . designed and built by Pioneer-Central . . . continues to be *first choice* for sound reasons:

First, Bendix has the most practical, most concentrated experience in making oxygen equipment.

Second, Bendix consistently leads in oxygen equipment development and improvement. It introduced the first continuous-flow oxygen system, the first diluter demand system, and the first effective liquid oxygen converter, to name a few.

Third, Bendix has in development today new oxygen equipment to meet the future demands of even higher-performance aircraft.

If you're concerned with selection of oxygen regulators, liquid oxygen converters and complete liquid oxygen systems, talk to PIONEER-CENTRAL DIVISION, BENDIX AVIATION CORPORATION, DAVENPORT, IOWA.

**An Example of Better Bendix Oxygen Equipment**

Type 2894
(Military Types MD-1 and MD-2)
Automatic Diluter Demand Pressure Breathing Oxygen Regulator

This new-design regulator gives improved performance . . . yet saves both space and weight. Currently being installed in the North American F-100 pictured above. Accepted standard for both Bureau of Aeronautics and USAF. Meets requirements of MIL-R-25410. Models for both high- and low-pressure, gaseous and liquid oxygen systems.

*PIONEERING is our business*

West Coast Office:
117 E. Providencia Avenue,
Burbank, California
Export Sales and Service:
Bendix International Division,
205 E. 42nd Street,
New York 17, New York
Canadian Distributor:
Aviation Electric Ltd.
200 Laurentien Blvd.
Montreal, Quebec

Pioneer-Central DIVISION

Bendix AVIATION CORPORATION

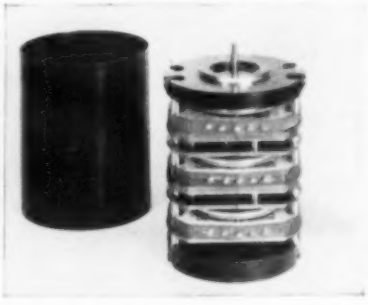

400 mc. will supplement previous studies at lower frequencies. Two large special radars will be used in the program. One is a 50 kw. FM transmitter modified for pulse transmission at 100 mc.; the other will use a large klystron capable of generating up to 70 kw. at 200-400 mc. Both transmitters will be mounted in van-type shelters. Large 60-foot diameter parabolic antennas designed by SRI, capable of being moved in both azimuth and elevation, will be used.

## NEW AVIONIC PRODUCTS

### Computer Devices

• **Magnetic core storage unit,** Model 1092-BU-7, for use as a temporary store, buffer or delay unit, has capacity for 1,092 characters each up to 7 bits in length. The 7 bits of each character are loaded and unloaded in parallel. The characters are introduced into the storage unit sequentially and are immediately available at the output in the same sequence. Minimum loading or unloading time is 14 microseconds with 6 microseconds needed to switch from a loading to unloading operation. Telemeter Magnetics, Inc., 2245 Pontius Ave., Los Angeles 64, Calif.

• **Small digitizer,** for converting analog data into binary coded decimal digital form, comes in basic three decimal digit model weighing 8 oz. and measuring 2 in. dia. x 2½ in. long. Additional decimal places can be obtained by adding modules each of which adds



¾ in. in length and 2 oz. in weight. Manufacturer says that unique code and dual brush system eliminates readout ambiguity. Federal Telephone & Radio Co., Clifton, N. J.

• **High-speed magnetic shift register,** Model DK107, operates at speeds up to 500 kc. with maximum digit repetition rate above one megacycle, uses two cores per bit. Unit comes in encapsulated case with miniature tube base. Airtronics, Inc., 5522 Dorsey Lane, Washington 16, D. C.

## An example of the

# Bendix Red Bank

## complete line of high-altitude and missile inverters

As aircraft and missile performance continue to step up, Bendix Red Bank designers continue to lead the field in developing new, high-performance inverters and power packages.

We now offer a complete line of inverters from 6 VA to 5,000 VA, including advanced special-application units and missile type power packages like the one shown above.

If we don't have an inverter to meet your specific needs, we'll design one. For full details, write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Sales & Service: 117 E. Providencia Ave., Burbank, Calif.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N.Y.
Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, Quebec

**INVERTERS — 400-CYCLE OUTPUT**

| Type | Input | | Rated Output | | | Max Altitude at Rated Output | Approx. Wt. Lbs. | Designed to Gov't. Part No. |
|---|---|---|---|---|---|---|---|---|
| | Volts | Amps. | Volts | Phase | VA Rating | | | |
| 12128 | 27.5 | 1 | 26 | 1 | 6 | 35,000 | 2.2 | AN3496 |
| 12126 | 27.5 | 2 | 26 | 3 | 10 | 35,000 | 2.3 | E1615 |
| 32B21 | 27.5 | 3 | 115 | 1 | 20 | 50,000 | 5 | — |
| MG-93 | 27.5 | 12 | 115/200 | 1<br>3 | 100<br>100 | 65,000 | 10 | E5134 |
| MG-54 | 27.5 | 22 | 115/200 | 1<br>3 | 250<br>250 | 50,000 | 17 | E5109 |
| 12142 | 27.5 | 22 | 115 | 1<br>3 | 250<br>250 | 35,000 | 13 | E1617 |
| 12143-1 | 27.5 | 22 | 115 | 3 | 250 | 35,000 | 13 | — |
| 12143-2 | 27.5 | 22 | 115 | 1 | 250 | 35,000 | 13 | — |
| *32B15 | 27.5 | 22 | 115 | 3 | 300 | 50,000 | 14 | — |
| 32E01 | 27.5 | 35 | 115 | 3 | 500 | 50,000 | 26 | AN-3533-1 |
| 32E00 | 27.5 | 51 | 115 | 1<br>3 | 500<br>750 | 50,000 | 34 | AN-3534-1 |
| MG-65 | 27.5 | 52 | 115/200 | 1<br>3 | 750<br>750 | 50,000 | 35 | E52805-2 |
| MG-61 | 27.5 | 126 | 115 | 1 | 1750 | 50,000 | 54 | 53C6767 |
| 1518 | 27.5 | 126 | 115 | 1<br>3 | 1500<br>1800 | 20,000 | 37 | — |
| 32E06 | 27.5 | 160 | 115/200 | 1<br>3 | 2000<br>2250 | 50,000 | 56 | E1725 |
| 32E03-3 | 27.5 | 150 | 115 | 1 | 2500 | 50,000 | 58 | 53B6227 |
| *32E03-8 | 27.5 | 160 | 115 | 1 | 2500 | 50,000 | 65 | 53B6227 |
| *MG-77 | 27.5 | 150 | 115/200 | 3 | 2500 | 50,000 | 65 | — |
| *32B49 | 27.5 | 160 | 115/200 | 1<br>3 | 2500<br>2500 | 50,000 | 65 | E54807 |
| MG-81 | 27.5 | 160 | 115/200 | 1<br>3 | 2500<br>3000 | 50,000 | 61 | E1725 |
| MG-95 | 27.5 | 160 | 115/200 | 1<br>3 | 2500<br>3000 | 50,000 | 58 | E54807 |
| 32E09 | 27.5 | 160 | 115 | 1<br>3 | 2500<br>3000 | 50,000 | 60 | — |
| 32B27 | 27.5 | 285 | 115/200 | 1<br>3 | 3500<br>4000 | 50,000 | 76 | — |

*These inverters have magnetic amplifier "static" type voltage and frequency regulators.
NOTE: D.C. Input Voltage shown is nominal value of 27.5 volts, but all units are designed for 26 to 29 volt operation. Input amperes shown are rated at 27.5 volts input.

Red Bank DIVISION

Bendix AVIATION CORPORATION

# WANTED! ENGINEERS TO HELP MAKE LONG RANGE MISSILE HISTORY

North American's Missile Projects Offer A New Engineering Adventure

With complete weapons system responsibility for the SM-64 NAVAHO Intercontinental Guided Missile, North American is engaged in one of the most challenging programs yet offered. But every inch of progress is a tough scientific battle. New means are daily being found to solve the complex problems which the development of long range missiles presents in the fields of structures, temperatures and aerodynamics. But most important of all, *men* must be found who thrive on this kind of challenge . . . men who are really excited about this new missile science. Are you one of them?

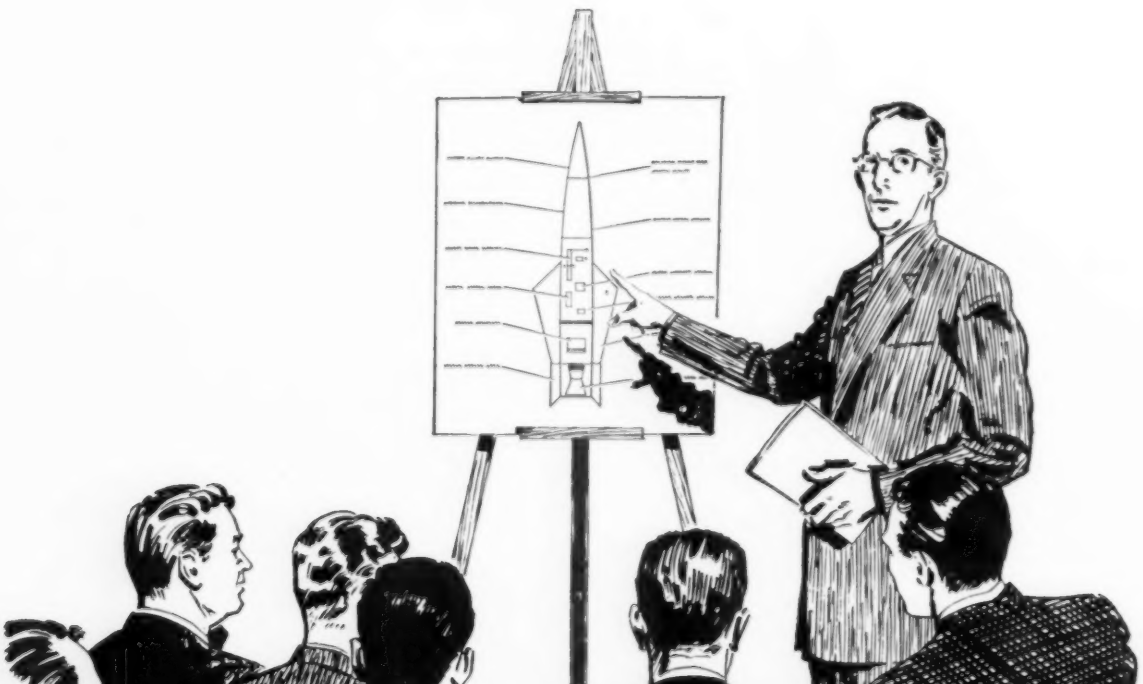
If you qualify in one of the fields we have listed below, chances are you can qualify for this unique expedition into the technology of the future. We would like to tell you about all the physical and professional advantages of a career in North American's Missile Development Engineering.

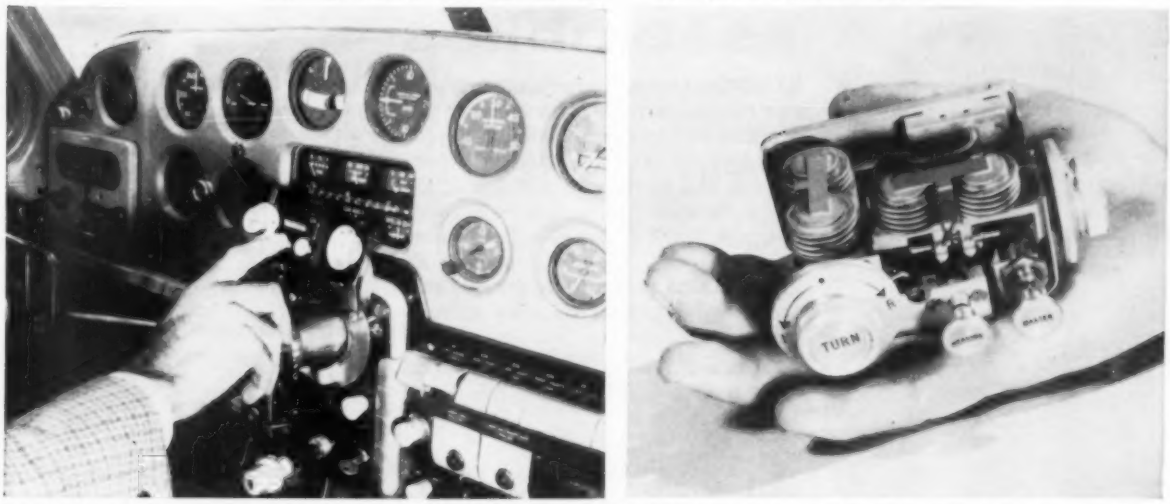
**Please contact us for the full story:**

**Instrumentation Design, Development & Application** **Standards, Drawings Checking, Specifications Writing**
**Structures, Stress, Flutter and Aeroelasticity** **Component and System Reliability Engineering** **Thermodynamics**
**Missile Airframe Design** **Hydraulic, Pneumatic & Servo Engineering** **Armament Systems & Components Engineering**
**Aerodynamics** **Engineering Flight Test** **High Temperature Materials Engineering** **Mechanical & Electrical Design**

**Contact:** Mr. M. Brunetti, Missile Engineering Personnel Office
Dept. 91-11 AW, 12214 Lakewood Boulevard, Downey, Calif.

## NORTH AMERICAN AVIATION, INC.






**TACTAIR T-3 CONTROL HEAD** has two pairs of aneroid capsules (right) which transmit commands from control knobs to control servos.

# Business Autopilot Goes to Distributors

By Erwin J. Bulban

**New York**—First units of the new Tactair T-3 lightweight low-cost three-directional autopilot designed specifically for business aircraft are reaching distributor's shelves following three years of development and flight test. Priced at $2,395, the T-3 weighs less than 10 lb. installed and is applicable to airplanes through the Beech 18 class.

The T-3 design embodies two major features:

- **No electrical power** is required, the unit being pneumatically powered.
- **Heading lock** is incorporated that will bring the airplane on selected course from a steering of up to 90 deg. either direction. There is also a heading "memory" that will automatically return the airplane to any pre-selected course should the pilot manually override the autopilot.

## Modified Instruments

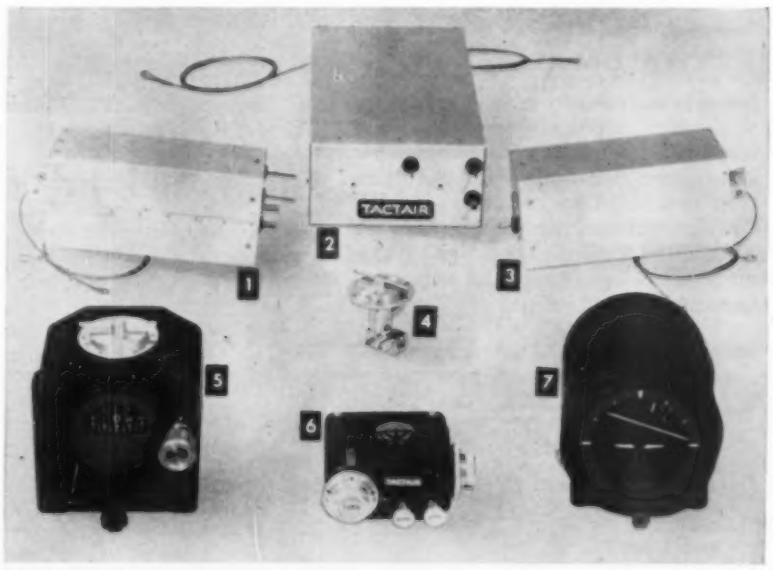
Pitch and roll control is taken from sensing units on the artificial horizon and heading is received from the directional gyro. In purchasing the T-3, the buyer turns in his horizon and gyro and receives two fully overhauled and modified instruments as part of the installation.

Manufacturer of the T-3 is Tactair Autopilot Division of Aircraft Products Co., Bridgeport, Pa.

Operation of the T-3 is based on adaptation of the air gage, a laboratory-type instrument used to measure infinitesimal tolerances. The air gage indicates pressure change as the amount of air space varies over a suction hole. These air gages are incorporated in the T-3's directional gyro and artificial horizon, with precision cams in these instruments moving as the gyros register changes in the plane's attitude. As the cams move, they vary the gap of air over the suction holes.

This change provides variance in the amount of suction, giving highly accurate sensing to pneumatic amplifiers which then relay the information to the servos that activate the aircraft's controls.

Suction is derived from the aircraft engine's vacuum pump. To operate the sensing units, the suction operates at four inches of mercury. The actual servos or bellows that actuate the plane's controls operate on an eight-inch vacuum and can exert up to 125 lb. force, far more than is required to




**COMPLETE T-3 PACKAGE:** (1, 2, 3) Pneumatic servos for left aileron, elevator, right aileron; (4) master shut-off valve; (5) directional gyro, with heading card installed above regular compass card; (6) command head control and (7) modified artificial horizon.

# smaller . . . lighter assemblies

KELOX tapped and threaded inserts provide new opportunities for reducing the size and weight of assemblies. Patented "key-locking" produces no stress concentrations and allows complete use of external threads for maximum holding power. KELOX design affords minimum depth of insert. The ability of KELOX inserts to withstand high torques has been verified without reservation by an independent laboratory.

Available for all external thread sizes from 0 to 3 inches, low-cost KELOX inserts are easy to install and remove . . . made of many materials (alloy steel, corrosion-resistant steel, aluminum alloy, brass, monel, etc.) . . . come with thick or thin walls for use with most materials—aluminum, magnesium, plastic, "pot" metal, titanium, steel, etc.

## EXTRA LARGE

The ever-increasing use of extra-large KELOX inserts (up to any specified diameter) is a result of their unmatched performance—a performance that verifies the "key-locking" principle. KELOX inserts will not rotate or loosen with vibration . . . make optimum use of tapped hole . . . provide maximum holding power . . . save weight and space.

## EXTRA SMALL

Sub-miniature inserts in 0, 1, 2, 3, and 4 thread sizes, *made only by KELOX*, will make miniature assemblies even smaller and lighter. Identical to regular non-rotating KELOX inserts . . . do not break down protective coatings like ceramic . . . require no special threads . . . give maximum reduction of space and weight for improved product design.

KELOX® trademark

4275

KELOX®

**Fasteners, Inc.**

580 Fifth Avenue
New York, N. Y.

**SALES REPRESENTATIVES**

Universal Fasteners Co.
Centerville Road
P.O. Box 449
Sturgis, Michigan

D. R. & W. Technical
Service Company
P.O. Box 4
East Hartford, Connecticut

Scott Fittings Limited
339 Bering Ave.,
P.O. Box 169
Toronto 18, Canada

F. D. Barringer Company
542 Spring Street, N. W.
Atlanta 3, Georgia

Monogram Manufacturing Co.
8557 Higuera Street
Culver City, California


work most aircraft control systems. Neoprene tubing connects the system's components.

The variable sensing, inherent in a pneumatic system, eliminates the "on-off" action of electrically operated autopilots and Tactair claims that control forces are applied more smoothly with their unit. Simplicity and weight savings are enhanced with the elimination of follow-up linkages which are not needed because of Tactair's inherent force follow-up. Linkage of the servos to the controls is direct. The T-3 remains passive except when changes are indicated.

### Basic Elements

Installation components comprise the command control in the cockpit measuring 3½-in wide x 2-in. deep and the three control boxes containing the basic sensing and amplifier valving and bellows-type servos to actuate the controls. One box combines two servos for elevator control; the other units handle the ailerons.

Rudder control units were considered unnecessary for the modern types of aircraft on which Tactair contemplated initial installations, since most of these are basically controlled directionally by aileron, rudder acting merely as a trim. A separate rudder control system is being developed for addition to the basic T-3 late next year.

The T-3 is instantly engaged by depressing the engagement button on the command control. Since there are no electrical components, no warm-up time is required. Straight flight and turns are made with the knob on the face of the command head, or, if the heading lock is engaged, with the directional gyro. Turning the knob provides standard three degrees per second turns. Level flight is controlled by another knob on the right of the control head. Aneroid capsules inside the control head relay commands to the control servos.

The course selector consists of an additional circular heading card installed by Tactair above the standard compass card in the directional gyro. To steer a selected course, the pilot sets the heading card to the desired point, then pushes the heading lock. The T-3 will then bring the airplane to that course and hold it there.

### Next Installation

Currently approved for all models of the Beech Bonanza, the T-3 is scheduled for installation next on the Cessna 180 and Piper Tri-Pacer; approvals for twin-engine models, including the Beech D18S and E18S, are expected to be received from Civil Aeronautics Administration in the first six months of 1957.

The manufacturer has had CAA ap-

proval on the Bonanza for two years and pilot models have been undergoing field testing on four Bonanzas in the Philadelphia, Pa., area since then. Tactair has been holding up detailed announcements on the T-3 until the units reached distributor's shelves.

Originally the company planned a starting production run of 100 units; reaction from the field as a result of demonstrations to prospective distributors has prompted the manufacturer to increase the first run to 600 units. It plans output to attain 50 units monthly in February. As a result of recent negotiations it is possible that one of the major business aircraft manufacturers will make the T-3 available to purchasers of its airplanes as factory-installed equipment at an early date.

To date, Tactair's distributor lineup includes: Atlantic Aviation Service, Inc., Wilmington, Del.; Atlantic Aviation Corp., Teterboro, N. J.; Page Airways, Rochester, N. Y., (which received the initial production models); Beckett Aviation, Pittsburgh, Pa.; Ohio Aviation Co., Dayton, Ohio; Youngstown Airways, Youngstown, Ohio; Aircraftco, Wichita, Kans.; and Norman Larson Co., Van Nuys, Calif.

M-185 mockup is checked by Steve Brown (left) and maintenance chief Leonard Lee.

# Pilot Cites M-185 Jet Economy

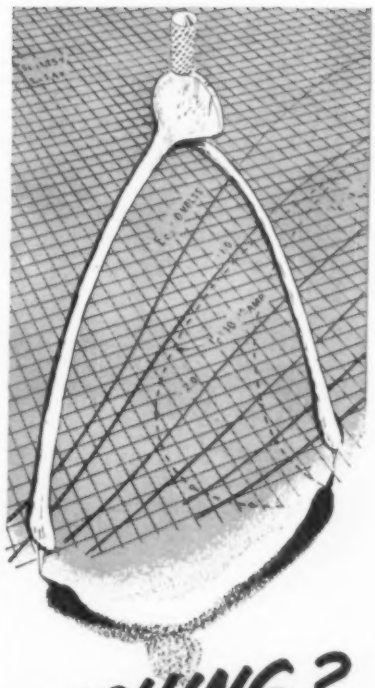
**New York**—Four-jet Fairchild M-185 executive transport will have a lower per mile operating cost than Continental Can Co.'s current piston-engine business planes, Chief Pilot Steve Brown asserts.

Using the Air Transport Assn. formula on a minimum of 600 hours annual flying time, Brown calculates that the M-185 will cost $1.05 per mile to operate versus $1.20 per mile for the company's Lockheed Lodestars. He also figures that the jet will fly cheaper per mile than the turboprop-powered Fairchild F-27, which Brown calculates will cost $1.18.

Three M-185's are scheduled for delivery to Continental Can beginning in 1960 and an F-27 in July 1958 (AW Sept. 3, p. 100). Brown says that these four new aircraft will increase the number of air miles available to the company by almost 100% and will enable Continental Can executives to fly 50% more mileage at twice the speed of the firm's present fleet.

Brown says that the M-185s will cost the company approximately $950,000 each and the F-27 $750,000 fully equipped. Amortization on the planes is calculated over a 10-year period.

Any company using 300,000 mi. or more of air transportation annually can use a jet in the M-185's class profitably, he states. He also noted that the M-185 will reduce deadheading time. The M-185 can fly from Miami, Fla., to New York City in 2 hr. 20 min., compared

WISHING?

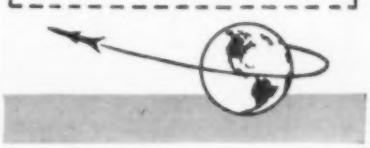
**if** you're wishing for a challenging, vital position — wishing to work with eminent and respected colleagues and excellent facilities within an atmosphere of constant research and development, *your wish can come true!*

**ENGINEERS** — ELECTRICAL, MECHANICAL, AERONAUTICAL
**PHYSICISTS**
**MATHEMATICIANS**

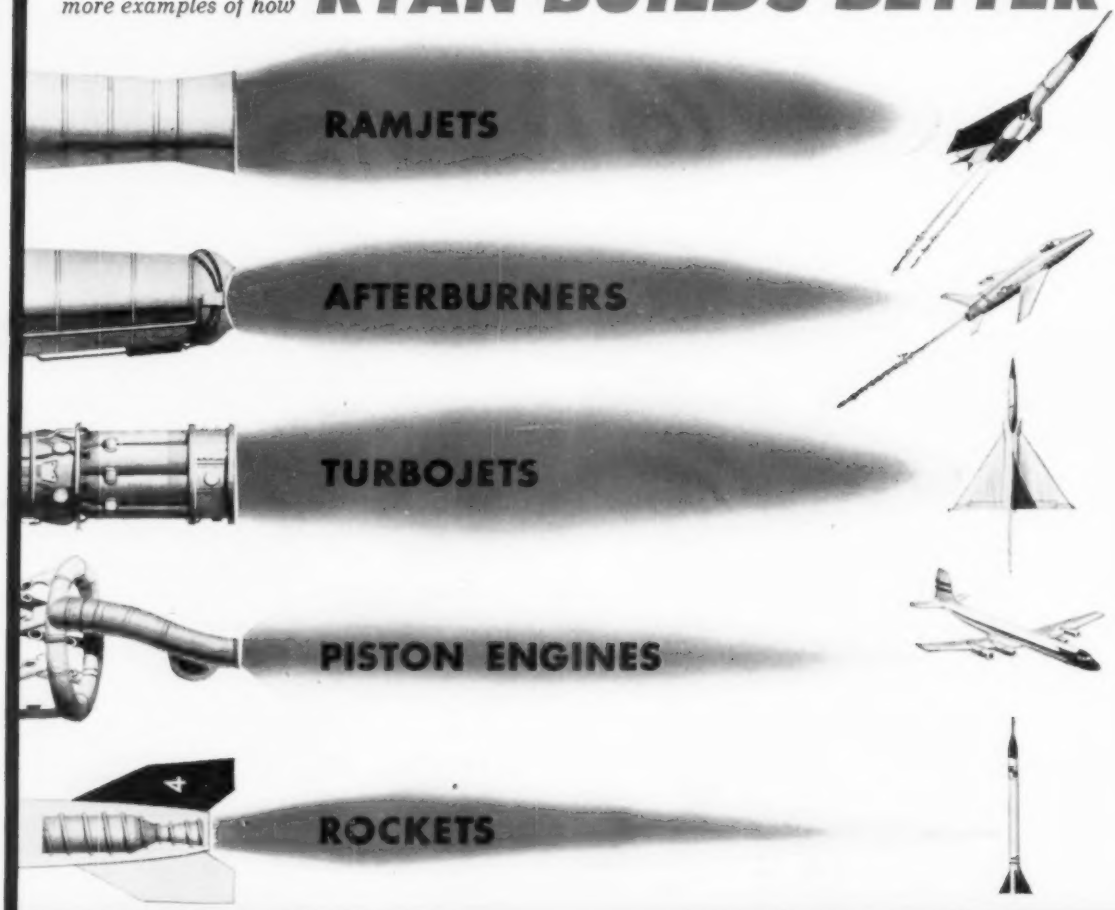
INERTIAL GUIDANCE SYSTEMS . . .
gyroscopic devices
servomechanisms
electronic components
airborne digital computers

*write:*
MARTIN PHILLIPS
personnel director
**INSTRUMENTATION LABORATORY**
Department of Aeronautical Engineering, M.I.T.
68 Albany Street
Cambridge 39, Massachusetts

GRADUATE COURSES
may be taken for credit while earning full pay.



*more examples of how* **RYAN BUILDS BETTER**




# HOT PARTS TO HURDLE THE THERMAL BARRIER

**High speeds in flight** mean high temperatures—up to 5000°F! In this new region of intense heat where ordinary metals melt like butter, Ryan metallurgists are pushing back thermal barriers with every new design. And Ryan production experts are *building* the hottest, fastest hot parts demanded by modern aviation.

**Ryan is uniquely skilled** and equipped in this important field—able to draw upon its extensive stockpile of experience in the design, research and production of major high temperature jet age items. Dramatic proof of Ryan's leadership shows up on the production lines where ramjets, afterburners, turbojets, piston and rocket engine assemblies are precision manufactured, in quantity, to the highest quality standards.

**BUILDING AVIATION PROGRESS SINCE 1922**

*Aircraft • Power Plants • Avionics*

**RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIF.**

Ryan

## Comanche Useful Load To Be 1,100-1,200 lb.

**New York—New Piper Comanche four-place business plane will have a useful load of 1,100 lb. in the 180-hp. version and 1,200 lb. in the 250-hp. model, according to first data revealed by the manufacturer. Standard fuel capacity will be 50 gal., providing a five-hour range. There will be provision for 10-gal. auxiliary fuel.**

**Two models of the new PA-24 Comanche will be made. As reported exclusively in Aviation Week (Oct. 22, p. 30), Piper will introduce one version with a 180-hp. Lycoming engine selling for approximately $13,500 to be delivered beginning April 1; another model with a 250-hp. Lycoming selling for about $16,900 will be available about Dec. 1. No speed data has been released to date pending flight tests of the second prototype. It is expected that the 250-hp. Comanche will be 25 mph. faster than the 180-hp. model.**

with six hours using current equipment, he says. "We could deadhead the M-185 at 50 cents a mile, because our only cost factor would be prorated crew salary, fuel and maintenance," he points out.

Brown also feels that jet business transports will be safer and easier to fly than current obsolete piston-engine aircraft.

In calculating M-185 operating costs, he doubled the per mile fuel cost recommended by ATA, because unlike major airlines, most corporate aircraft operators purchase fuel at retail rates at the various fields they use. Continental Can, which maintains a fuel supply at its Morristown, N. J., Airport base, could save five cents a gallon on jet fuel by bulk purchases, but, as Brown points out, it still would have to buy 50% of its requirements at higher rates elsewhere.

In addition to Continental Can Co., Continental Oil Co. has also ordered a Fairchild M-185. Three other large corporations are discussing purchase of the jet transport.

## PAC Buys Conversion Facility From Lear

**New York**—Pacific Aircraft Corp., Burbank, Calif., purchased the complete facilities of Learcraft Conversions, Inc., including the Aircraft Engineering Division of Lear, Inc., Santa Monica, Calif., builder of Learstar multi-engine executive transports. The facility also handled modification, maintenance and overhaul of executive DC-3s, Convair 340s, Beech 18s, Aero Commanders and other planes.

Lear Aircraft Engineering Division's projects will continue to be handled by PAC without interruption utilizing personnel of the former Lear subsidiary. Renamed PacAero Engineering Corp., it will be operated as completely separate corporation by the new owner. Vernon B. Benfer, former general manager of the Lear division, is president of PacAero.

Purchase price of the acquisition was not disclosed. It involves transfer of 70,000 shares of Pacific Airmotive Corp. stock, and is retroactive to Nov. 1, 1956. The new facility adds 75,000 sq. ft. of hangar space and 170,000 sq. ft. of ramp area to PAC's plant.

## Air Taxi Services Show Gains for 1956

**St. Louis, Mo.**—Members of the National Air Taxi Conference report they carried 87,319 passengers in 1956, an increase of some 8,000 over last year. Total revenue passenger-miles this year were 7,491,242, an increase of more than 1 million over 1955. NATC officials noted that the year's operations just concluded were carried out with a 100% safety record.

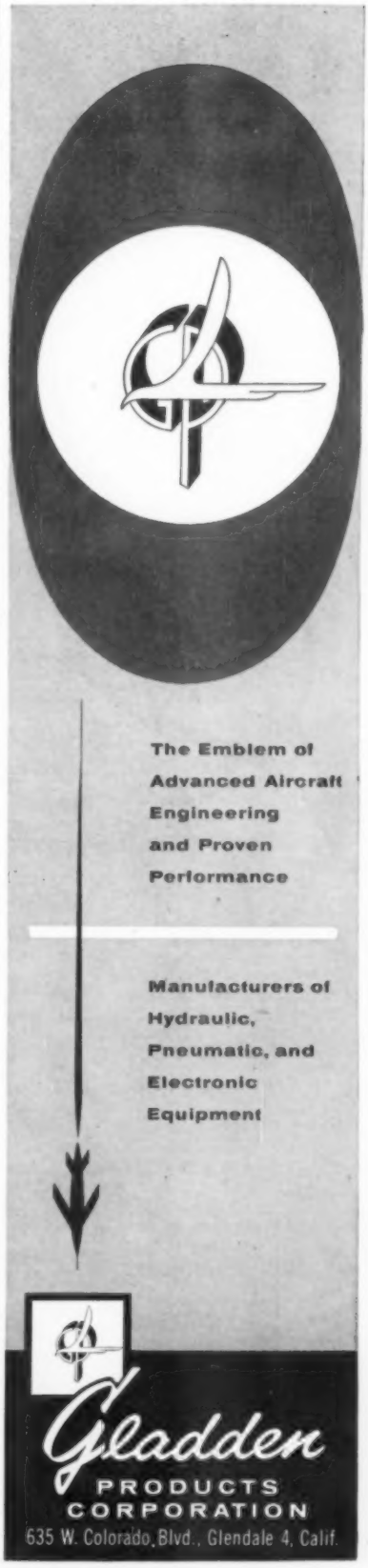
New NATC officials elected at the air taxi organization's annual meeting were: President, William J. Lotzer, Air Taxi, Inc., Division of Gran-Aire, Inc., Milwaukee, Wisc.; 1st vice president, K. V. Brugh, Jr., Greensboro-High Point Air Service, Inc., Greensboro, N. C.; 2nd vice president, W. Clayton Lemon, Air Taxi Service, Roanoke, Va. Representatives named were: Julius Goldman, Revere Airways, Revere, Mass., and Norman Larson, Norman Larson Co., Van Nuys, Calif.

## PRIVATE LINES

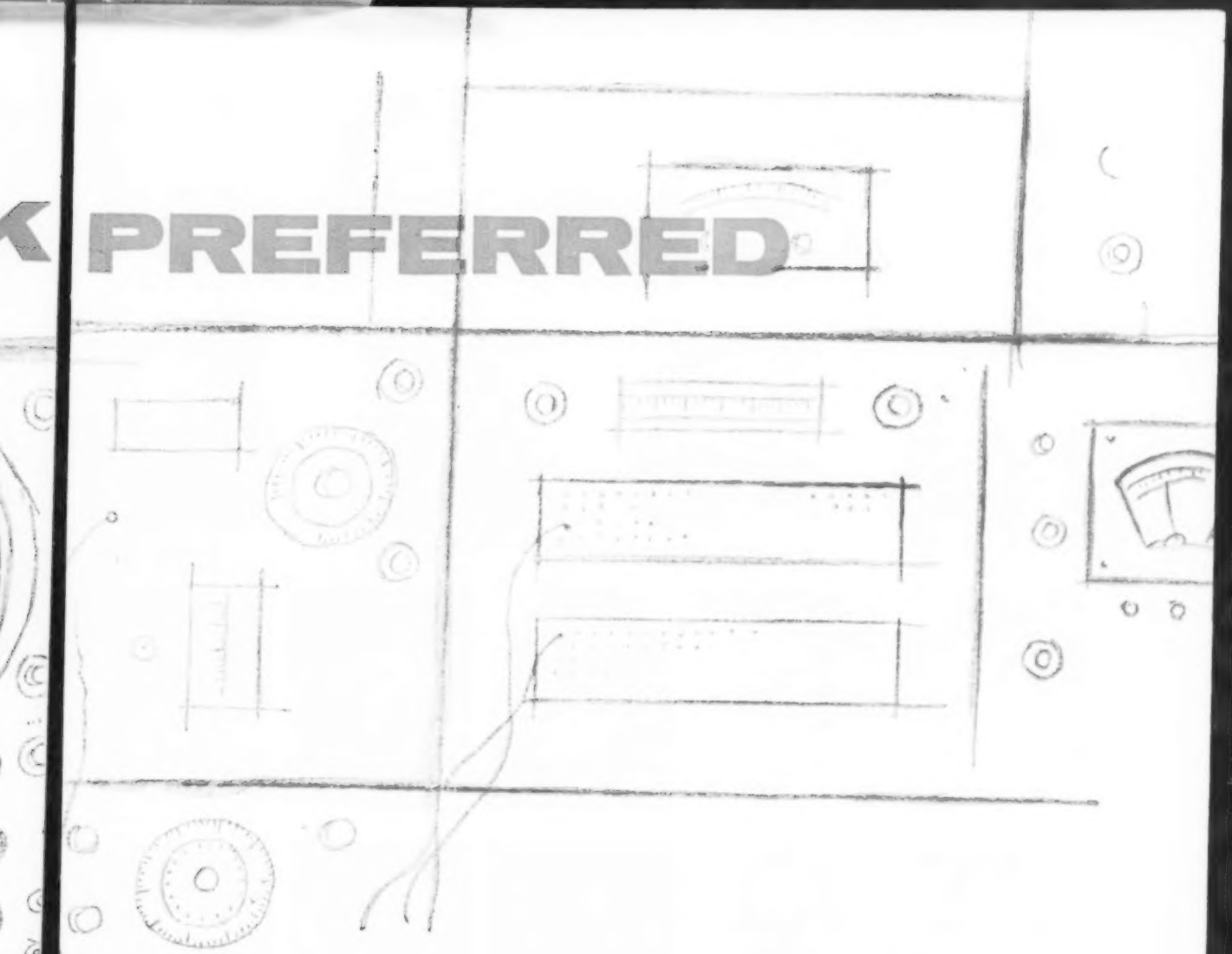
**Vickers Viscount 801D** turboprop transport has been purchased by Niarchos Group, major oil tanker operator, for movement of executives and crews.

**Traffic Coordinating Committee,** Detroit, Mich., approved trial use of a helicopter for solving traffic problems. The helicopter will be borrowed from Bell Aircraft Corp., through Whirlair, Inc., Detroit City Airport. Detroit's police commissioner favors using the craft not only to help on traffic problems but also for rescue work and waterfront patrol.

**Wings, Inc.,** Wings Field, Pa., canceled its sales agreements with Beech Aircraft Corp. and Piper Aircraft Corp., and signed a direct factory dealer contract with Cessna Aircraft Co.

AVIATION WEEK




MAKE NO MISTAKE . . . Aviation's biggest news today consists of the latest scientific and engineering developments which make possible tomorrow's aircraft. The prime source for this vital information is AVIATION WEEK . . . preferred by aviation's engineering-management men because . . .

Working to fulfill their "need to know" are 23 full-time editors — graduate engineers and aviation specialists. Possessing the technical knowledge and industry experience needed, they ferret out, analyze and report in detail aviation's significant technical developments *when they happen*.

Competitive advantage in this fast-paced industry depends on *when* the latest is learned. AVIATION WEEK's fastest publishing schedule in the industry guarantees its readers this advantage.

AVIATION WEEK's high-interest engineering-management readership (Contact your local AVIATION WEEK representative who would like very much to expand on this point) has led to overwhelming advertiser acceptance . . . AVIATION WEEK carried *4,298* pages of advertising in 1955, more than the combined total of the three next highest ranking aviation business publications and another record is already in the making for 1956.

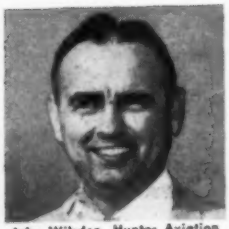
**UY AVIATION'S LARGEST ENGINEERING-MANAGEMENT AUDIENCE, BUY** AVIATION WEEK

ABP ABC A McGRAW-HILL PUBLICATION
330 WEST 42ND STREET, NEW YORK 36, N.Y.

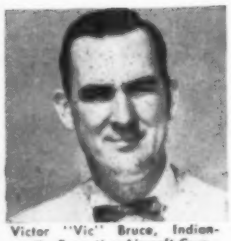
Don Vest, Vest Aircraft & Finance Co., P. O. Box 5306, Sky Ranch Airport, Denver, Colorado.

Gene Hudman, Stonnell and Holladay Aircraft Sales, Carolina Division, Municipal Airport, Charlotte, North Carolina.

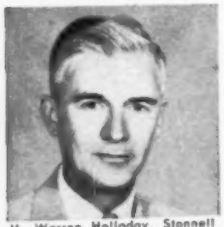
Peter Graves, Southern Ohio Aviation Sales Co., Dayton Municipal Airport, Vandalia, Ohio.



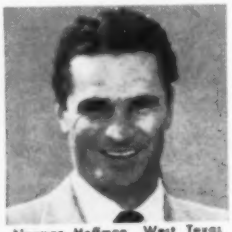
John Wilsdon, Hunter Aviation Co., P. O. Box 122, Lambert Field, St. Louis, Missouri.



Victor "Vic" Bruce, Indianapolis Executive Aircraft Corp., Indianapolis Municipal Airport, Indianapolis, Indiana.



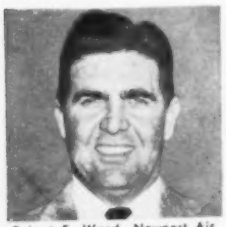
H. Warren Holladay, Stonnell and Holladay, 843 Washington Building, Arlington Towers, Arlington, Virginia



Norman Hoffman, West Texas Flying Service, Midland Airport, Box 82, Midland, Texas.

Art Meurer, Arthur Meurer Co., Inc., LaGuardia Field, New York, N. Y.

John S. Brown, Brown Aero Corp., 3100 Love Field Drive, Dallas, Texas.



Robert F. Wood, Newport Air Park, Newport, Rhode Island.

Wynn Cronje Minnesota Airmotive Inc., Minneapolis-St Paul International Airport Minneapolis Minnesota

A. M. "Sime" Bertolet, Reading Aviation Service, Inc., Municipal Airport, Reading, Pennsylvania.

H. Leibee Wheeler, Buffalo Aeronautical Corporation, Buffalo Municipal Airport, Buffalo, New York.

Max R. Brand, Aero Commander Dist. (Downtown Airpark), Hangar 3, Municipal Airport, Tulsa, Oklahoma.

E. H. "Ted" Tolan, National Aero Sales Corp., Midway Airport, Chicago, Illinois.

W. D. Maddox, Aero Southern Corp., 601 North Broadway, Nashville, Tennessee.

W. H. "Bill" Buchanan, Sales Manager, Johnson Air Interests, Inc., Harlick-Racine Airport, Racine, Wisconsin.

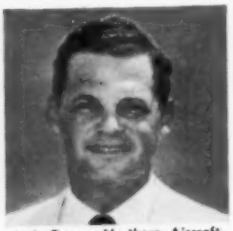
Louis Humphreville, Executive Aircraft Corporation, Municipal Airport, Pontiac, Michigan.

Jack Hale, Chamberlain Aviation, Inc., Akron Municipal Airport, Akron, Ohio.

John A. "Jack" Bauman, Santa Monica Aviation, 3011 Airport Avenue, Municipal Airport, Santa Monica, California.

Herrol Bellomy, L. B. Smith Aircraft Corp., Miami International Airport, Miami, Florida.

Lucien M. Taillac, Trans-Aire Corporation, Pan-Air Building, New Orleans Airport, New Orleans, Louisiana



Jack Gregg, Northern Aircraft Co., International Terminal Building, International Airport, Oakland, California.

Robert M. Brown, Commander Sales Company, Terminal Building, International Airport, San Antonio, Texas.


NATION-WIDE SALES and SERVICE

AERO DESIGN Commander

AERO DESIGN AND ENGINEERING COMPANY

TULAKES AIRPORT • OKLAHOMA CITY, OKLAHOMA

*CAB Accident Investigation Report:*

# DC-3 Pilot Lost Sight of Airport, Crashed

## THE ACCIDENT

A West Coast Airlines DC-3, N 62374, flew into the side of a hill 1¼ miles northeast of the runway threshold during an approach to Pullman-Moscow Airport, Pullman, Wash., about 1940,[1] Feb. 26, 1956. The aircraft was substantially damaged and the copilot and two of the twelve passengers received minor injuries.

## HISTORY OF FLIGHT

West Coast Airlines' Flight 97 of Feb. 26 was a scheduled passenger flight between Idaho Falls, Idaho, and Spokane, Wash. with intermediate stops at Pocatello, Burley, Twin Falls, Boise, and Lewiston, Idaho; and Pullman, Pasco, and Walla Walla, Wash. It departed Idaho Falls at 1430 and flew routinely to Boise, where a scheduled crew change was made. The new crew consisted of Captain Houghton H. Whithed, First Officer Alfred R. Klein, and Flight Attendant Clifford E. Hammond.

An IFR flight plan was filed at Boise and the flight departed there at 1706. Following a normal landing at Lewiston, Captain Whithed checked the weather with the company's station agent at Pullman, and the flight departed Lewiston at 1916 with 12 passengers. Gross weight of the aircraft was 23,518 lb., 2,228 lb. below that allowable, and the load was properly distributed.

When in the vicinity of Pullman, at 1929, an ADF (Automatic Direction Finder) instrument approach was made, using the company's "H" facility, and visual contact was established at 3,500 ft. msl. The aircraft flew over the airport and then made a right turn, followed by a left turn, planned to align with the runway.

During this maneuver a small snow squall was encountered and momentarily the captain lost visual contact. Shortly thereafter the aircraft struck the side of a hill and crashed in a snow-covered field.

## INVESTIGATION

Inspection at the scene, which was open, rolling farmland, disclosed that the aircraft had made its first contact at a point 1¼ miles northeast of the airport while moving on a course of 230 degrees. (The runway is aligned on a 229-degree heading.) The altitude of the point of contact is 2,660 ft. msl., 109 ft. higher than the runway. Flight 97 had failed by 50 ft. to clear a round-topped hill, which lies between the point of contact and the airport. Three to 10 in. of snow covered the ground at the scene and plainly registered the initial imprint of the wheels and the sequence of contacts that followed.

First impact, which occurred while the aircraft was in a nose-high attitude, caused both main wheels to fail rearward driving each drag strut upward through the wing; the second ground contact was made 100 ft beyond the first, and the aircraft then skidded 650 ft.

Both propellers were broken from the engines and both engines were broken from their mounts. The aircraft came to rest in an upright attitude on the bottom of its fuselage.

Examination of both engines and both propellers indicated that they were capable of normal operation prior to impact. Examination of the airframe disclosed repairable impact damage to the center section, the fuselage bottom, and the nacelles but disclosed no defect that could have existed prior to impact. Both outer wing panels also suffered major damage.

The airport at Pullman has a single landing strip, 100 ft. wide and 4,931 ft. long, aligned 229 degrees and 49 degrees magnetic. Hills, reaching 100 to 250 ft. above the landing strip, lie in all directions within one mile.

The company-owned "H" facility is located near the center of the landing strip. West Coast Airlines uses two ADF approach procedures: No. 1, which requires reference to a commercial broadcasting station that operates on week days only, was not available on Sunday, Feb. 26; No. 2 specifies:

"Initial approach from the south at 5,100 ft. Outbound track is 225 degrees from the 'H'. Procedure turn is to the south, minimum altitude 4,000 ft. Maximum distance 25 mi. Minimum altitude over the 'H' on final approach is 3,500 ft.

"If visual contact is not established over the 'H' on final, or landing is not accomplished the following 'Missed Approach' procedure is established. Turn left and climb to 5,500 ft. on a 225-degree track from the 'H' within 10 mi. of the station."

A stationary front existed from Vancouver Island across southern British Columbia, thence southeastward through eastern Montana during the afternoon of Feb. 26, 1956. At the same time an occluded front was moving eastward across western Washington. To the south and east of these two fronts, namely, eastern Washington and western Idaho, a westerly flow of relatively cold unstable air existed.

At the time the flight departed from Boise, en route weather was being reported as generally overcast with light rain at Walla Walla, light snow at Spokane and Pullman, and precipitation generally over the mountains.

Ceilings were being reported ranging from 1,200 to 5,000 ft. and visibility 10 mi. or better, except three-quarters of a mile at Pullman.

The area forecast available to the flight at Boise indicated the following expected conditions en route: Broken to overcast, with ceilings mostly 4,500 or better but occasionally lowering in snow showers to ceiling 800, sky obscured, visibility one to three miles.

Snow showers were expected to be frequent over all mountains. The terminal forecast for the Spokane area after 2000 was gusty southwest wind and occasional ceiling 600, sky obscured, visibility one mile, light snow and fog. The Lewiston terminal forecast was ceiling 3,000 overcast, occasional light rain showers, wind south-southwest 12. No terminal forecasts are issued for Pullman.

### Company Station Called

Testimony of flight crew and dispatch personnel disclosed that at 1855, prior to departure from Lewiston, Flight 97 called the company station at Pullman and requested the local weather.

The reply was, "Special No. 15 1850 Pacific time: precipitation, ceiling 1,000 ft.[2] obscuration; visibility 2 mi.;[3] light snow; temperature 30; dewpoint 30; wind southwest 8." The flight then requested the runway condition and was told there was a thin layer of ice, the braking was "fair," and it looked all right to come in. This was the last weather requested or received by Flight 97.

At 1929 the flight reported over the "H" facility at Pullman. Captain Whithed started his ADF approach, and extended and checked the landing gear. This approach was completed in a routine manner and visual contact was established over the southwest end of the runway (which is 2,551 ft. msl.) with the obstruction lights in sight.

After visual contact had been established Captain Whithed flew over the runway for its entire length and noted his heading as 50 degrees while descending to 3,100 ft., and advanced power to 25-26 in. to maintain that altitude.

Reaching the eastern end of the runway and moving out over the unlighted area east of the airport, the captain started a restricted-visibility procedure turn. This maneuver is used to assist the pilot in reversing his course and provide a means of staying fairly close to the runway on which he plans to land and be certain that on completion of the procedure he will be aligned with the runway and at the right position to complete his final approach and

[1] All times herein are Pacific standard and are based on the 24-hour clock.

[2] WCA's night approach limits at Pullman-Moscow were 900 ft. ceiling and 2 mi. visibility. After this accident they were changed to 1,000 ft. and 3 mi. with descent prohibited unless all runway lights could be seen.

[3] The weather observer on duty testified that the actual observation of visibility at night is limited to the farthest lighted target; to the east this is three-fourths mile.

# engineers:

## Cessna's "NEW LOOK" provides greater opportunities than ever!

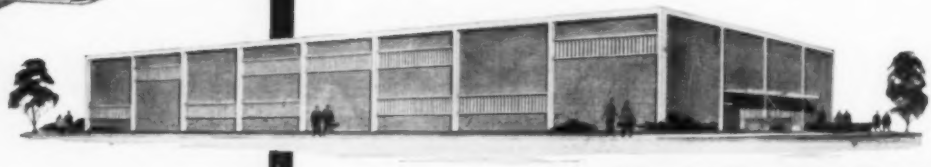
Our plan for continuous, controlled expansion—based on a healthy balance between military and commercial aircraft projects—pays off for you! Creative freedom and an unhampered pursuit of challenges are part of your "heritage" at Cessna—and, the new, two-story, 44,000 square foot building illustrated below—designed exclusively and specifically for our engineers—can be your new home at Cessna.

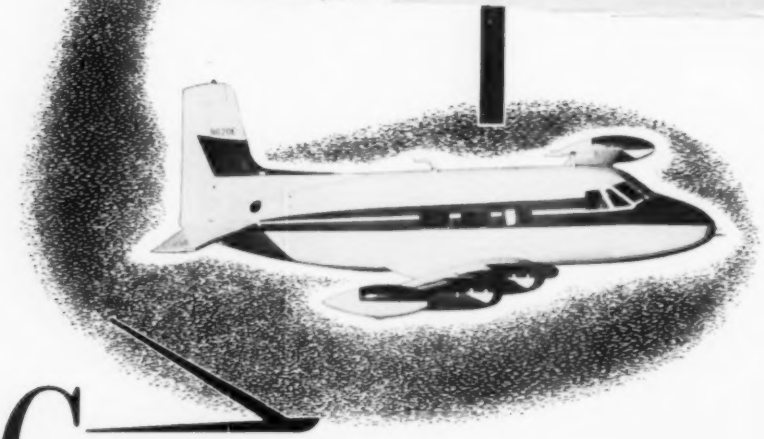
You and your family will enjoy making Wichita your home, too! It was not without much forethought that the founders of Cessna located here. Third fastest-growing city in the United States, Wichita is a friendly city . . . a busy city . . . ideal for family life and recreation. The school system is excellent . . . with above-average facilities . . . easily accessible in all residential districts. Why not join Cessna—and GROW with Cessna? Your future is our future!

## Opportunities available for

- Airframe Design Engineers
- Weight Control Engineers
- Power Plant Installation Engineers (Jet and Reciprocating)
- Airframe Stress Analysts
- Instrumentation Engineer
- Equipment Installation Engineers
- Design Draftsmen
- Technical Illustrators
- Catalog and Maintenance Writers
- Electrical Engineers

*(Competitive salaries to qualified applicants)*
**NON-CITIZENS WELCOME**





**write, wire or call**

*Professional Placement Supervisor*

**Cessna Aircraft Company**
**Dept. AW**
5800 East Pawnee Road
Wichita, Kansas

# Cessna AIRCRAFT COMPANY

landing by visual means. Accordingly, he made a standard rate right turn to a heading of 95 degrees and held it for 40 seconds. Thereafter he executed a standard rate left turn to the runway heading of 230 degrees.

This series of maneuvers performed at 3,100 ft. and 110 kt. throughout was calculated to end with the aircraft aligned with the runway on the proper heading. During much of the final turn few, if any, lights on the ground were within the angles of vision from the cockpit. At the approximate instant of completing the procedure turn the flight encountered a snow squall, which reduced visibility to zero for an estimated 10 seconds.

Captain Whithed testified that during this interval on instruments he reached for his throttles to abandon the approach but changed his mind when the airport lighting again became visible and completion of the landing appeared to be a routine matter. (Copilot Klein was calling out the airspeed which still was about 110 kt. at that time.) Captain Whithed saw that he had reached a point from which the airport lights were on a bearing about 10 degrees farther south than he had planned.

Captain Whithed testified that he then altered his heading an estimated 10 degrees to the south to bear upon the lights at the threshold and he continued his approach, starting his descent along a path a little to the north and at a small angle from the projected centerline of the runway. At that time he reduced his manifold pressure to about 19 in., and his speed to 90 or 95 kt. A moment later his only landmark, the lights on the airport, disappeared.

### Visual Loss

Believing the loss of visual reference to be only another snow squall he attempted to initiate a missed approach by climbing through the squall. He told his copilot to raise the gear (flaps had not been extended) and to shut off carburetor heat; he, Whithed, opened the throttles, pulled back on the elevator controls, and started reducing propeller pitch.

The airplane had been put into a climbing attitude at about 90 kt. but had not started to climb when at 2,660 ft. msl., it struck the snow-covered hillside which was in its path to the runway threshold. At the time of impact the copilot had not had time to retract the gear and it was still locked down.

During the preliminary maneuvers of the approach, Flight Attendant Hammond checked the passengers' safety belts and found them all properly buckled. At impact one girl passenger was thrown from her seat into the aisle although the belt had not broken. Passenger evacuation through the main passenger door was started. The captain and first officer came through into the cabin and assisted in the handling of the evacuation, which was discontinued as soon as it became apparent there was no danger of fire.

Three to 10 inches of snow on the ground and falling snow, with wind, estimated by Captain Whithed to be 30 to 35 m.p.h., made it less comfortable outside. The cabin door was left open, and passengers went out and in while waiting for removal.

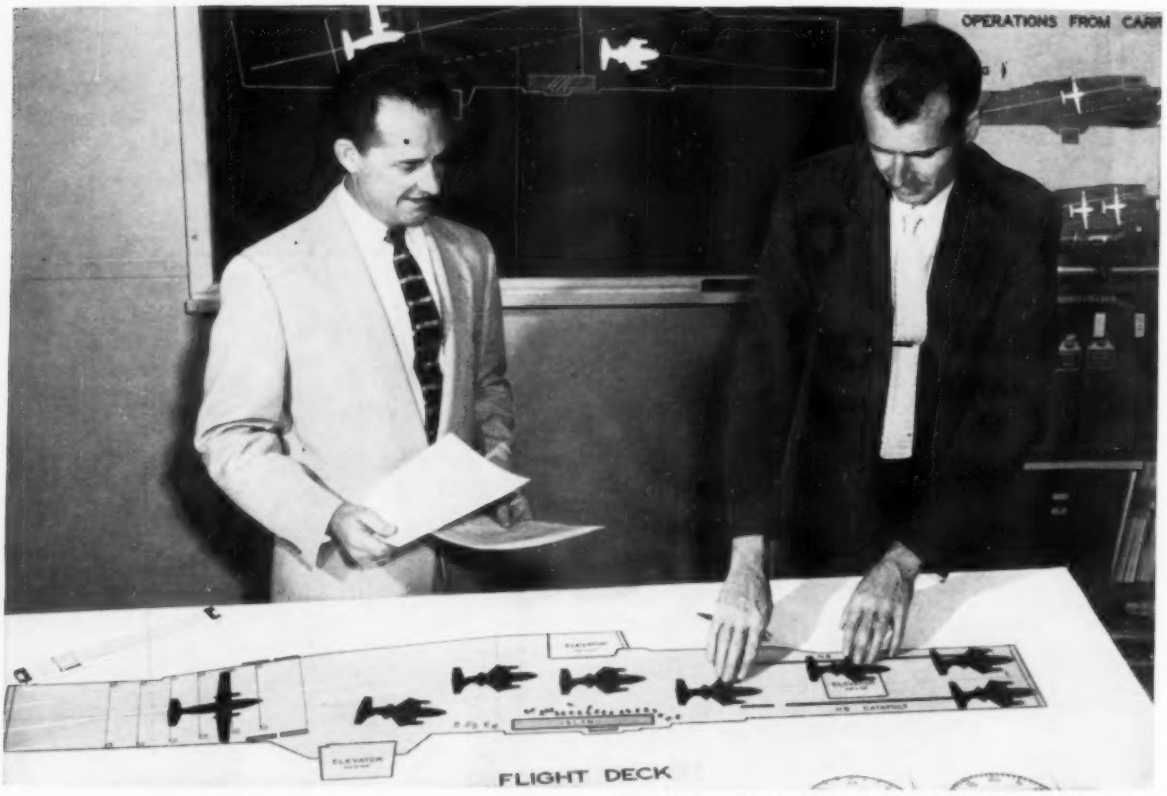
One passenger, Dr. Loehr, a practicing physician from Moscow, Idaho, was well

TEAMWORK
Whittaker gyros are designed and built by a staff of engineers and technicians that has remained practically intact for more than a decade.
By working together, they have been able to produce gyros that are unsurpassed for strength, accuracy and reliability. The proof is in Whittaker's overall customer rejection of less than 2%.
Whittaker Gyro
DIVISION OF TELECOMPUTING CORPORATION
VAN NUYS, CALIFORNIA
STANLEY 7-5511

AIRCRAFT TUBING
GOVERNMENT SPECIFICATION TUBING IN STOCK..

| 4130 GRADE | | 4135 GRADE | 1025 GRADE |
|---|---|---|---|
| • AMS - 6371 | • AN-T-69 | • AMS - 6372 | • MIL-T-5066 |
| • MIL-T-6736 | • AN-WW-T850a | • MIL-T-6735 | • AN-WW-T846 |

SERVICE STEEL • DETROIT, MICHIGAN
LOS ANGELES, CALIFORNIA




Fairchild Operations Engineers, Plez P. Moody and Robert A. Booth study aspects of a carrier-on-board delivery plan involving the C-123 assault and logistics transport.

# OPERATIONS ENGINEERS

The Operations Engineering Section of the Projects Administration Department of Fairchild Aircraft Division offers opportunities for graduate engineers capable of conducting aircraft utilization analysis.

These assignments require knowledge of and experience in:

- **Airworthiness Requirements**
- **Performance Analysis**
- **Power Plant Specifications**
- **Route and Mission Determination**

At the present time, these assignments relate to the Fairchild C-123 cargo transport, the Fairchild Friendship turboprop passenger transport, and the Fairchild M-185 jet utility transport.

The opportunities and salaries associated with the new positions are commensurate with the responsibilities of the work. Employee benefits in the form of group insurance, individual and family coverage for hospitalization, retirement plan, sick leave, etc., are also provided.

Send complete resume of education and experience,
together with salary requirements to:
**EMPLOYMENT MANAGER – P.O. BOX 134**

...WHERE THE FUTURE IS MEASURED IN LIGHT-YEARS!

**FAIRCHILD**

**AIRCRAFT DIVISION • HAGERSTOWN 10, MARYLAND**

*A Division of Fairchild Engine and Airplane Corporation*

acquainted with the terrain. He examined all in need of attention; one girl with nose bleed, the copilot with facial lacerations, and a woman who thought the shock may have caused injury to her back.

Then he and the captain sought and found a farmhouse with a telephone. After Captain Whithed reported the location of the aircraft, the farmer used his tractor and a trailer to assist passengers to the highway and ambulances removed all occupants to the local hospital for examination.

## ANALYSIS

The weather records, communications, logs, and the crew testimony disclose that the flight was entirely routine until it reached the Pullman-Moscow Airport, completed the instrument approach, and the circling approach had advanced to the very end of the planned 225-degree turn into final.

While this turn was being made darkness and the lack of visible lights in the sky or on the ground prevented continuous reference to visual landmarks and compelled flight by reference to instruments.

The weather as recorded, reported to the flight crew, and observed by them was above authorized minimums except for about 10 seconds while the aircraft was passing through a snow squall. During that 10-second interval Captain Whithed decided to abandon the approach, but when he emerged from the snow squall and reestablished visual contact, he reversed his decision.

Captain Whithed had landed at Pullman-Moscow many times and felt quite familiar with the approach pattern he was following. Although he was slightly north of his alignment upon starting the final leg, he considered the correction for this to be no additional hazard as he then had the runway lights in sight.

He continued his approach following a pattern that was normal except for the small deviation toward the north. When the lights ahead disappeared again the captain, according to his testimony, thought a second snow squall was in his path straight ahead, and as the condition seemed to be worse than reported and to be below minimums, he tried to abandon the approach.

But the restriction to visibility ahead was not merely airborne snow; it was in fact a snow-covered hill, or more likely a snow-covered hill shrouded in falling or wind-driven snow. In fact, at this point the aircraft had actually descended too low to clear the terrain. Whithed also testified that when he pulled the plane up it did not stall, but he did feel it descend as if in a downdraft.

In his attempt to pull out for a go-around, Captain Whithed had changed the attitude of the aircraft to tail-down, thus getting much of the effect of a flare-out and probably reducing the force of impact a great deal.

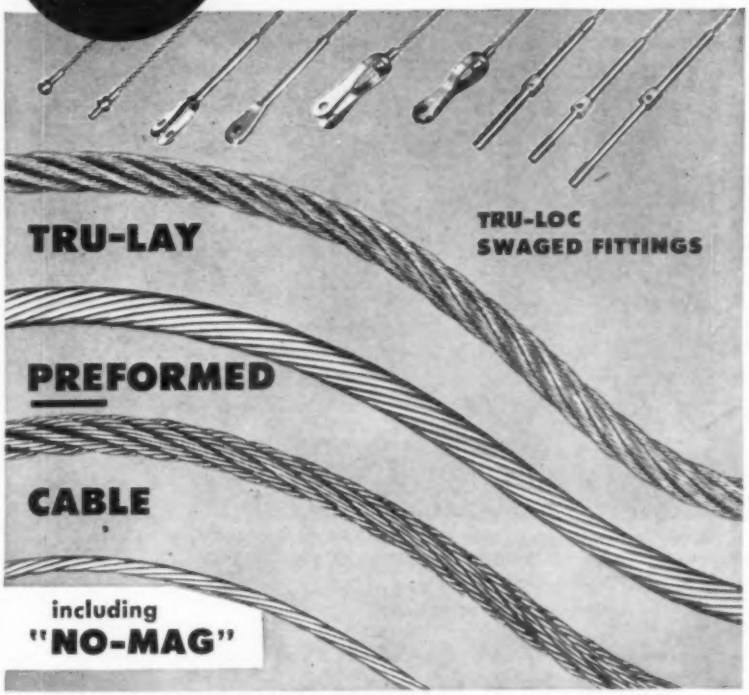
## FINDINGS

On the basis of all available evidence the Board finds that:

1. The aircraft and both pilots were properly certificated for the flight involved.
2. The company records show that the


ACCO products

TRU-LAY Cables
TRU-LOC Fittings




Solving Aircraft Design Problems...

is an old story to ACCO. The originators of preformed cable and swaged terminals for aircraft use, ACCO engineers have now introduced new non-magnetic aircraft cables. The complete line of ACCO cables and fittings now includes . . .

**New "No-Mag" Cable — ends instrument interference**

New "NO-MAG" Aircraft Cables are made from Type 305 stainless steel. Their advantages include:

- Remain non-magnetic even after severe cold working—eliminate instrument interference through cable magnetism.
- Better corrosion-resistance properties than standard stainless steel cables.
- Thermal expansion characteristics are much closer than standard cable to characteristics of aluminum alloys used in aircraft—this simplifies maintaining cable tension under changing temperatures.
- High fatigue and abrasion resistance.
- Preformed construction.

**TRU-LAY Cable** Provided in all standard stainless and carbon steels in a complete range of sizes and constructions. Because it is preformed it

- Can be cut without seizing.
- Is easier to handle—less tendency to loop or kink.
- Can be installed in less time.
- Is free of tendency to rotate—runs true over sheaves or pulleys—is easier on pulleys.
- Has greatest resistance to bending fatigue—gives longer service.

**TRU-LOC Swaged Fittings**

- Guaranteed to hold to the rated breaking strength of the cable with which used.
- Eliminate costly, uncertain splicing.
- "*Quickies*"—specially developed double-shank ball-type terminals—make it possible to connect and disconnect control sections in an instant without tools.

*Write Detroit office for specifications*

ACCO
Automotive and Aircraft Division
AMERICAN CHAIN & CABLE

601 Stephenson Building, Detroit 2
2216 So. Garfield St., Los Angeles 22 • Bridgeport 2, Conn.

Aircraft Cable • Swaged Fittings

MALLORY·SHARON reports on

TITANIUM

Chance-Vought Crusader on flight deck of the U.S.S. Forrestal. The Navy recently set a new U.S. speed record of 1015 m.p.h. with the Crusader in winning the Thompson Trophy event.

## Crusader's dark tail— sign of a bright future

Inspection of tail cone assembly. By its emphasis on consistent titanium quality, Mallory-Sharon simplifies work required in fabrication.

● Notice how the fuselage gets darker as your eyes look fore to aft?

The dark area identifies the use of titanium for the tail cone that covers the jet engine. Titanium is the *only* light metal that can stand the intense heat. Thus titanium alloy is used for the entire tail cone, including outer skin and inner bulkheads and support members. The use of hundreds of pounds of titanium alloy here saves precious weight, helps put the Crusader in the over-1000-mile-per-hour class.

With each new or improved aircraft design more titanium from Mallory-Sharon is used . . . this remarkable metal is a dependable, uniform material. For example, Mallory-Sharon certifies the uniformity of titanium mechanical properties, and guarantees optimum machineability. For quality you can depend upon, call Mallory-Sharon for your requirements in titanium.

MALLORY-SHARON TITANIUM CORPORATION, NILES, OHIO

MALLORY Ti SHARON

## SAFETY

aircraft was loaded within allowable limits as to the amount and distribution of weight.

3. The weather was forecast to be within limits for the entire operation.

4. The weather encountered by the flight was generally as forecast.

5. Snow squalls encountered along the final approach path could not be observed from the weather station at Pullman-Moscow, and could not be seen by Flight 97 until it had actually entered them.

6. At the last moment of Captain Whithed's turn into final, loss of visual reference caused slight misalignment with the runway.

7. Captain Whithed accepted this misalignment as something he could correct without significant reduction of safety, and continued his approach.

8. The aircraft descended too low to clear the terrain ahead.

9. Visual reference to the airport was lost a second time and the airplane struck a snow-covered hill 50 ft. below its top while a missed approach was being initiated.

## PROBABLE CAUSE

The Board determines that the probable cause of this accident was the continuation of a landing approach following loss of visual reference to the airport, and the delayed attempt to execute a missed approach.

By the civil aeronautics board:

/s/ James R. Durfee
/s/ Chan Gurney
/s/ Harmar D. Denny
/s/ G. Joseph Minetti

Adams, vice chairman, did not participate in the adoption of this report.

## SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident at 2015, Feb. 26, 1956. An investigation was started immediately in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. The investigation included examination of the physical evidence at the scene and of the company records. Also depositions were taken at Seattle, Wash., on Mar. 15 and 16, 1956.

## AIR CARRIER

West Coast Airlines, Inc., is a scheduled air carrier incorporated in the State of Washington. It maintains its headquarters at Seattle, and operates DC-3 aircraft on scheduled routes in Washington, Oregon, and Idaho. It possesses a currently effective certificate of public convenience and necessity for route No. 77 issued by the Civil Aeronautics Board and air carrier operating certificate No. 702 issued by the Civil Aeronautics Administration which authorize carrying of persons, property, and mail between various places in the area and over the route prescribed.

## FLIGHT PERSONNEL

Captain Houghton H. Whithed, age 40, held a valid airman certificate No. 54764 with rating as airline transport pilot on DC-3 equipment. Company records show he had logged 13,984:24 hours, of which 10,030:24 were in DC-3s, and 682 hours were instrument flying. His last physical

*A message to the* *Career-Conscious Engineer:*

# Ready to change jobs?

**Perhaps you are not receiving a salary commensurate with your work.**

**Perhaps you are dissatisfied with your rate of promotion.**

**Perhaps you do not have enough scope for your ability in your present job.**

**Or perhaps you simply want to move to Southern California.**

We invite you to consider the California Division of Lockheed Aircraft Corporation as the place to re-establish your career. For these reasons:

**Promotional Opportunities are excellent** because there are so many supervisory positions to be filled with 46 major projects in progress at Lockheed and because Lockheed is in an expanding development and production program.

**You have more scope to show what you can do** because Lockheed projects range across virtually the entire spectrum of aeronautical endeavor. You are not limited to one type of work because Lockheed is so diversified in projects. Moreover, Lockheed encourages and welcomes personal initiative.

**You may receive a substantial increase in pay** because Lockheed is extremely liberal in direct salary and in extra employee benefits, which actually increase the value of your position by an average of 14%. *Engineers' salaries have been raised 19% in the last three and one-half years.*

**Positions are open** at all levels for engineers in fields of: Aerodynamics – Design – Electronics, with emphasis on systems and antenna design – Flight Test Engineering, particularly in instrumentation – Math. Analysis – Operations Research – Structures – Thermodynamics – Weight.

Space prevents us from listing all the reasons we believe you will find significant. There are many others. But if our brief remarks make sense to you, write us and we can explore your opportunities at Lockheed through personal interview or phone. The brief resumé below is simply for your convenience in contacting us.

**ADVANCED EDUCATION PROGRAM FOR ENGINEERS**

You can expand your technical knowledge and achieve advanced degrees through a variety of Lockheed-sponsored university programs that cost you little or nothing.

**TO ENGINEERS WHO LACK AIRCRAFT EXPERIENCE**

Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering – at full pay.

**Lockheed** AIRCRAFT CORPORATION

*California Division* BURBANK **California**

**E. W. Des Lauriers Dept. CJ-3-11-4**
**Lockheed Aircraft Corporation**
**Burbank, California**

*Dear Sir: Please send me your brochure detailing life and work at Lockheed.*

Name

If you are an engineer, please state your field of engineering

Home street address

City and State Home phone

# *A message to engineers from an engineer-president*

Marquardt was incorporated in 1944 by five engineers and three Los Angeles businessmen to explore the potential of the ramjet engine – then merely a laboratory curiosity.

Twelve years of sound engineering and research have really paid off. Today we employ over 2000 people at Los Angeles and Ogden, Utah and expect to triple in the next two years. Of course, many of our new associates will be in manufacturing –which is fine. Every engineer wants to see his "baby" accepted and in production. However, the outstanding work of our present engineering and research team has also opened up big new requirements for engineers in almost every specialty in areas varying from production engineering and qualification testing of present models to advanced research on startling new break-throughs in high speed propulsion – new chemical fuels and nuclear energy.

It is not too late to get in on the ground floor on engineering the ramjet engine – the powerplant of the future. Write me personally.

*Roy E Marquardt*

**Marquardt Aircraft Co.**
**Van Nuys, California**


## SAFETY

was dated Feb. 20, 1956, and his last six-months proficiency check was in September, 1955. He had been in the employ of the company since June 19, 1946.

First Officer Alfred R. Klein, age 33, held airman certificate No. 467204 with airline transport rating in DC-3 aircraft. He had a total of 6,598:40 hours, of which 467 hours were instrument time. His last physical was dated May 1955.

Flight Attendant Clifford E. Hammond, age 26, had been in the employ of West Coast Airlines since Oct. 2, 1955. In September 1955, he satisfactorily completed a test in emergency procedures.

### THE AIRCRAFT

Douglas DC-3, N 62374, manufactured Feb. 2, 1944, serial No. 12559, was owned and operated by West Coast Airlines.

It had logged time as follows:

Total–17,797:51 hours

Time since last major overhaul–120:45 hours

Time since line maintenance–46:55 hours

The powerplant engines were Pratt and Whitney, model 1830-90D:

| | Right | Left |
|---|---|---|
| Serial No. | 450358 | 316451 |
| Total time (hours) | 893:21 | 270:42 |
| Time since overhaul | 893:21 | 270:42 |
| Date manufactured | 5-25-41 | 6-13-44 |

The propellers were Hamilton Standard, model 23E50-473 hubs and model 6353A-18 blades:

| | Right | Left |
|---|---|---|
| Serial No. | 4257 | 54846 |
| Time–Total | 9,124:13 | 1,149:03 |
| Time since overhaul | 2,660:44 | 1,149:03 |
| Blades Nos. | 67688 | P-198186 |
| | 67689 | P-198187 |
| | 67690 | P-198188 |

## Foreign Sales Units Appointed by Vertol

**Morton, Pa.**–Preparing for foreign commercial as well as military sales, Vertol Aircraft Corp., manufacturer of the H-21 helicopter, has appointed 13 sales representatives in Europe, South America and Far East:

- **Belgium,** Aerobel, Brussels.
- **Denmark,** Mogens Harttung, Copenhagen.
- **France,** Helicop-Air, Paris.
- **West Germany,** Finanz-Und Verwaltungs-Gesellshaft, Bremen.
- **The Netherlands,** Schreiner & Co. N. V., The Hague.
- **Norway,** H. H. Broch, Oslo.
- **Spain and Portugal,** Carlos Cudell Goetz, Lisbon.
- **Sweden,** Salen & Wicander, A. B., Stockholm.
- **Switzerland,** Air-Import Corp., Lucerne.
- **United Kingdom,** Rotowings Ltd., London.
- **Peru,** Ingenieria Commercial S. A., Lima.
- **Venezuela,** Servicios Circa C. A., Caracas.
- **Japan,** C. Itoh & Co. Ltd., Toyko.

# from *Fancy* to FLIGHT in 10 weeks' time

Meet the "Gizmo"—245 pounds of portable versatility.

The "Gizmo" was born in the mind of a Goodyear Aircraft engineer. And, recognizing its importance to today's fast-moving armed forces, Goodyear Aircraft engineers transformed the idea into this low-cost, safe and simple one-man helicopter in 10 short weeks. Another great tribute to creative engineering—specialty of the house at Goodyear Aircraft.

Of course, significant developments like this are no accident. They are the harvest of imagination and ingenuity, cultivated by freedom of thought and expression.

The Goodyear Aircraft engineer knows that here his *every* idea has a chance. And, he knows, too, that at his disposal are the most modern facilities available, including one of the largest computer laboratories in the world. Here engineers find the stimulation of creative challenge and the satisfaction of realistic accomplishment.

If *you* are a creative engineer with faith in your ideas and confidence in your ability to make them work, here's your opportunity to become a vital part of this great creative team. For our growth and diversification make it necessary to expand our engineering staffs at both Akron, Ohio, and Litchfield Park, Arizona. Opportunities are unlimited for creative engineers in all specialties.

Salaries and benefits are, of course, liberal. And if you wish to continue your academic studies, company-paid tuition courses leading to advanced degrees are available at nearby colleges.

For further information on *your* career opportunities at Goodyear Aircraft, write:

Mr. C. G. Jones, Personnel Department, Goodyear Aircraft Corporation, Akron 15, Ohio.

***They're doing big things at***

**GOODYEAR AIRCRAFT**

**THE TEAM TO TEAM WITH In AERONAUTICS**

## AN UP-TO-EARTH VIEW OF THE FUTURE IN SERVO CONTROLS AND INSTRUMENTATION

The Martin launching vehicle of the first man-made Earth satellite will be the opening gun of a new and endless age of exploration into space.

There are many exciting new opportunities at Martin in the fields of servo controls development and instrumentation engineering.

If you are doing some down-to-earth thinking on this fabulous future you'd do well to contact J. M. Hollyday, Dept. AW-11, The Glenn L. Martin Company, Baltimore 3, Maryland.

**MARTIN**
BALTIMORE

## The Future Comes *SOONER* at RMI

**. . . sooner, because the engineers and scientists at America's *first* rocket engine company *make it* so . . . Your own future will come sooner, too, as a member of our record-setting staff.**

**MECHANICAL AND AERONAUTICAL ENGINEERS**

You will work on every creative phase . . . from analysis and design, through "hardware" and test of controls and accessories for rocket power plants of today and tomorrow.

Background should include a knowledge of the principles and problems associated with design, development and analysis of hydraulic or pneumatic power plant controls and systems.

**APPLICATIONS ENGINEER**

A responsible post, working with military and industrial customers on applications for aircraft pumps, valves, ignition systems and related products. Experience selling aircraft components necessary.

You will organize programs to apply existing and new designs to all types of aircraft and missiles. Involves technical liaison with customers to discuss requirements and determine applications. You should understand construction, operation and performance of power plants. Knowledge of military contracts and airframe industry desirable. Age to 45.

*Let us discuss your qualifications, our company and its benefits, in detail with you.*

*Send complete resume, including experience and salary requirements, in confidence, to:*

**Personnel Manager**

**REACTION MOTORS, Inc.**

*"First in Rocket Power"*

**60 Ford Road** **Denville, N. J.**

Affiliated with the
Olin Mathieson Chemical Corp

# DESIGN ENGINEERS

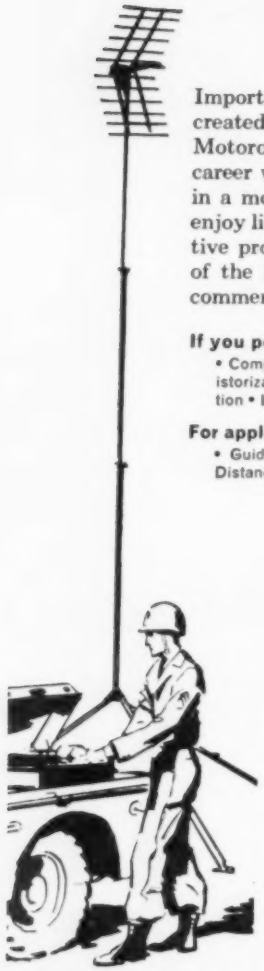
Your first concern is to put your best into a product. But don't overlook the education your product owes you . . . the broadening experience you need for advancement. Make the most of these opportunities in a career-conscious unit like Chance Vought's Design Operations Section. Here designers experience the complete cycle of engineering. Their functions include detail design, analysis and installation studies. They write correspondence, test requirements and procurement specs for specialized equipment. And when fabrication begins, they conduct liaison in their own plant and in vendors' shops. In this environment the designer matures rapidly into a well-rounded, systems-conscious candidate for key positions. Investigate your qualifications for these growth advantages. Send a resumé of your background to:

Mr. J. W. Larson, Asst. Chief Engineer
Engineering Personnel Dept. 11-3A

CHANCE VOUGHT AIRCRAFT
INCORPORATED • DALLAS, TEXAS

ENGINEERS • PHYSICISTS

# Big things are happening at the MOTOROLA MILITARY ELECTRONIC LABORATORY IN CHICAGO



Important assignments from the armed forces have created *new* and outstanding opportunities at Motorola. This is your challenge to advance your career with a swiftly expanding company, working in a modern, well instrumented laboratory. You'll enjoy liberal employee benefits, including an attractive profit sharing plan, and association with men of the highest technical competence. Salaries are commensurate with ability.

**If you possess the following techniques:**

• Computors • Indicators and displays • Miniaturization • Transistorization • Pulse Techniques and Special Waveform Generation • Linear and Nonlinear Servo-Mechanisms

**For application to systems in the following areas:**

• Guidance • Data Handling • Data Transmission • Precision Distance Measuring • Weapon Control • Navigation • Ground Radar

CHICAGO, ILL.
MILITARY LABORATORY
*write to:*
Mr. L. B. Wrenn Dept. G
4501 Augusta Blvd., Chicago 51, Ill.

PHOENIX, ARIZONA
RESEARCH LABORATORY
*write to:*
Mr. R. Coulter, Dept. G
3102 N. 56th St., Phoenix, Ariz.

PHOENIX, ARIZONA
SEMI-CONDUCTOR DIVISION
*write to:*
Mr. V. Sorenson, Dept. G
5005 E. McDowell Road, Phoenix, Ariz.

RIVERSIDE, CALIF.
RESEARCH LABORATORY
*write to:*
Mr. C. Koziol, Dept. G
Box 2072, Riverside, Calif.

**MOTOROLA**

## ENGINEERS

### CONTROL SYSTEMS

### Research and Development

**for**
**AIRCRAFT**
**NUCLEAR**
**PROPULSION**

Exceptional opportunities are now available in this General Electric Department for control systems engineers who want to be in the lead in their art. You can't be further ahead than the development of control systems for aircraft nuclear power plants. You can't find greater scope than this group charged with executing complete projects—from idea through research and development to testing

**OPENINGS EXIST AT VARIOUS LEVELS IN:**

- **Systems Analysis**
- **Servomechanisms**
- **Systems Applications**
- **Printed Circuits**
- **Environmental Testing**
- **Saturable Core Components**

**OPENINGS IN CINCINNATI, OHIO AND IDAHO FALLS, IDAHO**

In addition to these professional advantages, you'll enjoy the many personal benefits that go with being part of General Electric.

*Send reply in confidence, stating salary requirements, to location you prefer:*

**J. R. Rosselot**
P.O. Box 132
Cincinnati, Ohio

**L. A. Munther**
P.O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

*REPLIES (Box No.): Address to office nearest you c/o This publication Classified Adv. Div.*
*NEW YORK: P. O. Box 12 (36)*
*CHICAGO: 520 N. Michigan Ave. (11)*
*SAN FRANCISCO: 68 Post St. (4)*
*LOS ANGELES: 1125 W. 6th St. (17)*

### *POSITION VACANT*

**Contracts Manager—for aggressive and growing** aircraft company in the East. Good business training and military contracts experience required. P-3534, Aviation Week.

### *POSITIONS WANTED*

**Pilot ATR written, all land ratings, 5500 hrs.** diversified flying, extensive IFR, 3500 Multi-Eng., incl. Twin-Beech., B-25, C-46; 2400, hrs. DC-3, 2½ yrs. sched. airline, 4 yrs. college engrg. Age 36 family. Desire permanency. Resume on request. PW-3401, Aviation Week.

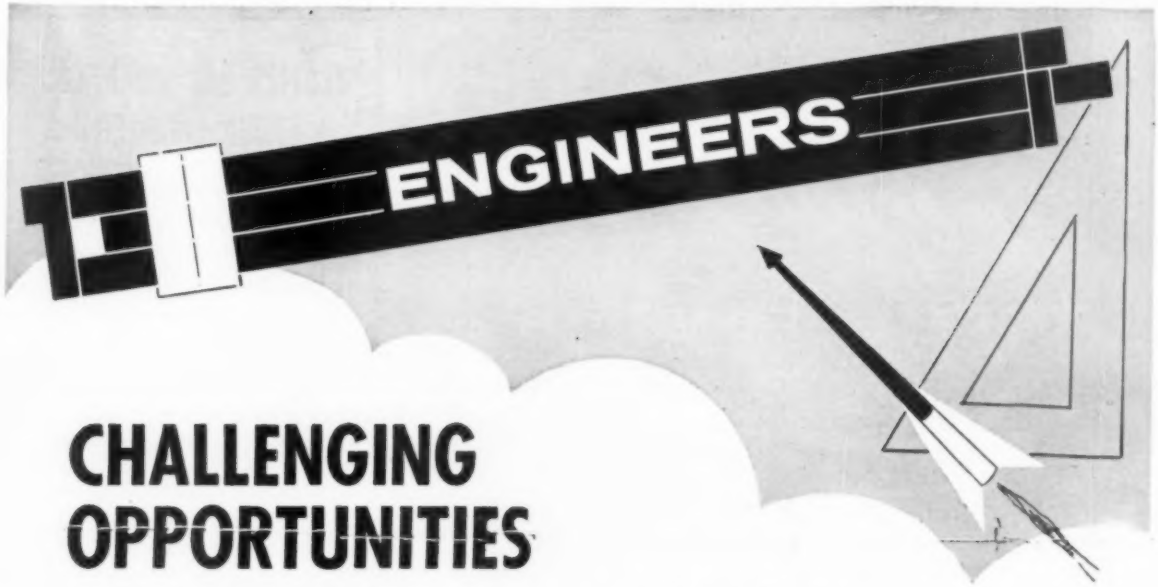
**Dayton Representative Available—Ten years** experience obtaining Air Force contracts. PW-3470, Aviation Week.

**Experienced pilot, age 32, family 5700 hours,** ATR, SMEL, type DC-3 4½ years airline experience, speaks Spanish, education in engineering, practical experience in contracting. Position with sound future will relocate any place. PW-3338, Aviation Week.

**ATR pilot SMEL 10 years airline experience,** 6000 hrs. currently chief pilot large corp. flying twin beechs. Desires change. No violations or accidents. 901 Rae Drive Minneapolis 23, Minn.

**Pilot Position Wanted—Commercial pilot,** single and multi engine land, instrument, instructor, 4500 hours total. Recent instrument and multi engine time. Age 28, married, college, A&E and sales background. Will relocate. PW-3515, Aviation Week.

**Airline Captain desires position as executive** or corporation pilot. Domestic & International experience as Captain on multi-engine aircraft. Currently flying as same. Excellent background in sales and organizational duties. Age 31, height 6'1", weight 167. A complete flying and personal resume available on request. PW-3555, Aviation Week.




# CHALLENGING OPPORTUNITIES

**IN**
- **Avionics**
- **Computers**
- **Jet Engine Fuel Controls**
- **Inertial Systems**
- **Missile Guidance**

***WITH AC THE ELECTRONICS DIVISION OF***

## General Motors

ALL GRADUATE ENGINEERS are offered permanent job opportunities. We extend a cordial invitation to every deserving Engineer and Designer to write us their wants. We may be able to supply the square hole for the square peg!

YOUR FUTURE depends on your making the right connection with the right firm as quickly as possible.

The men hired will enjoy working with some of the top men in the field and with the finest test, research and development facilities. GM's long-standing policy of decentralization creates individual opportunity and recognition.

Why not send us full facts about your education, work background, etc. We will do all we can to treat your application with the fullest confidence.

AC SPARK PLUG — THE ELECTRONICS DIVISION
**GENERAL MOTORS CORPORATION**
MILWAUKEE 2, WIS. — FLINT 2, MICH.

# WHAT *inspired*

## ARCHIMEDES

The driving urge to find a way to do a thing which had never been accomplished . . . then, to improve. Today, Farnsworth's electronics programs would tax the talents and imagination of these famous four . . . and

## DA VINCI

more. Tomorrow will obsolete today in the fantastic industrial revolution now being created through electronics . . . The Farnsworth tradition of superior competence in electronics research, development and pro-

## FARADAY

duction is now and will continue to be one of the most salable articles on the American scene. For the engineer desiring association with one of the country's pioneers in missile guidance and control, systems

## ROENTGEN

test equipment, radar, countermeasures, infra-red systems, antennas, microwaves, transistor and pulse circuitry, industrial electronics products . . . Write . . .

*Farnsworth*

A DIVISION OF IT&T

*Address Technical Employment Director*

**FARNSWORTH ELECTRONICS COMPANY, FORT WAYNE, INDIANA**

*A Division of International Telephone and Telegraph Corporation*

*Your resume will receive prompt, confidential attention.*



## FLUTTER and VIBRATION GROUP ENGINEER

To be responsible for flutter and vibration control of high speed airplane weapons system. Requires a working knowledge of theoretical flutter analysis of high speed aircraft, flight flutter testing, flutter model testing, and vibration theory and testing.

*Send resume to:*

**RAYMOND F. KALETTA**
Technical Placement Supervisor
P. O. Box 516
St. Louis 3, Missouri

**McDONNELL AIRCRAFT CORPORATION**



## RADIO AND ELECTRICAL SYSTEMS INSTALLATION ENGINEER

Familiar with low voltage DC aircraft equipment such as generators, starters, regulators, navigation and communication systems, and their installation. Experience in custom installations of such equipment on a variety of executive aircraft desirable.

Contact
Personnel Dept.

**PIPER AIRCRAFT CORPORATION**
LOCK HAVEN, PA.
*Phone Lock Haven 6711*
*Ext. 259*



## ENGINEERS

If you have been looking for an Employment Agency that is skilled in the **STATE OF THE ART** of Technical Recruitment and **RELIABILITY OF INFORMATION** concerning positions, why not communicate with us at once?

**FIDELITY PERSONNEL SERVICE**
1218 Chestnut St. Phila. 7, Pa.
*Specialists in Aviation and Electronics*



## HELICOPTER PILOTS & MECHANICS JOB OPPORTUNITIES AVAILABLE

Bell 47
Sikorsky S-55
Sikorsky S-58

**ROTOR-AIDS, INC.**
P. O. Box 1850 Ventura, California

## Technical Executive Shops Manager

This responsible and challenging career position with a large American owned aircraft engineering company based in the Far East, heavily engaged in contract maintenance and overhaul for the U. S. Air Force, is open to a top notch "go getter". Experience in the administration of overhaul and manufacturing shops servicing power plants, accessories, instruments and components is essential. A&E license required. Technical education desirable. Liberal salary!

P-3340, Aviation Week
Classified Adv. Dept., P.O. Box 12, N. Y.36 N. Y.

## STRESS ENGINEERS DYNAMICISTS

EXCELLENT OPPORTUNITIES
with
ESTABLISHED FIRM IN HELICOPTER INDUSTRY

SALARY OPEN

CALL OR WRITE

PREWITT AIRCRAFT COMPANY
E. MADISON & HOLLY AVES.
CLIFTON HEIGHTS, PA.
MADISON 6-6500

## PASSENGER SERVICE — MANAGER —

Minimum 2 years' experience in Supervisory capacity.

Locate on West Coast, Travel Internationally

*Our Employees Know of This Ad*

Write giving full details regarding age, education, experience and salary to:

P-3344 Aviation Week
68 Post St., San Francisco 4, Calif.

**THE HAPPIEST CALIFORNIA ENGINEERS ARE AT HELIPOT**

with a growth electronic company in a new $2,000,000 plant overlooking the blue Pacific. Top salaries, benefits. Sell your car—buy a boat. E.E.'s, M.E.'s, Mfg., Sales Engrs., ask for Fact File 6 **Beckman/Helipot**, Newport Beach 11, Calif.

## EXECUTIVE OPPORTUNITIES IN THE CESSNA SALES DIVISION

### REGIONAL SALES MANAGERS

- Executive management experience necessary in initiating and administering sales programs.
- Experience in supervising and directing a sales organization.
- Aircraft background desired.

### REGIONAL SERVICE MANAGERS

- Travel out of and headquarter in Wichita.
- Aircraft maintenance background desirable.
- Must be competent pilot.

### PARTS MERCHANDISING MANAGER

- Must develop and administer a spare parts merchandising program.
- Must aid dealers in setting up and operating parts departments.
- Must have automotive parts experience on zone manager level.

**CESSNA**

**If you meet these requirements and are interested in an unlimited opportunity with the World's Leading Producer of Executive Aircraft, send your resume and recent photograph to the Professional Placement Supervisor, Dept. AW, Cessna Aircraft Company, 5800 East Pawnee Road, Wichita, Kansas. (No phone calls, please.)**

*High Professional Potential in*

## CONTROLS ANALYSIS

A whole new family of high-power low-weight turboshaft, turboprop and turbojet engines are in progress today at this major company.

Controls Systems as precedent-breaking as the new engines must be developed. And there are a number of rewarding opportunities for engineers with the ability to give this development a firm, analytical basis.

Assignments include such operations as: determining and specifying engine controls parameters—providing performance specifications for systems and components—preparing data for analog computer studies—providing consultation service to Preliminary Design, Advanced Design and Project Groups—selecting and training controls analysis personnel and many other relative functions.

Advancement comes rapidly to engineers who demonstrate their capacity in the important field of Controls Analysis. This department is itself expanding. The operation is decentralized. Management on-the-spot makes the decisions. Your contributions are quickly recognized and rewarded.

**• GOOD STARTING SALARIES • RELOCATION EXPENSES PAID • ATTRACTIVE LOCATION • LIBERAL BENEFITS**

*Send reply in complete confidence to:*

**P-3188 AVIATION WEEK**
**Class. Adv. Div. P. O. Box 12, NY 36, NY**

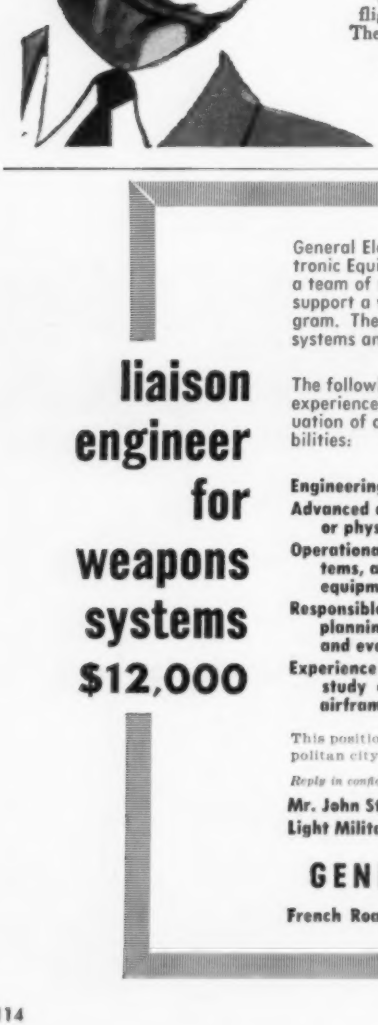
HERE'S WHAT YOU CAN LOOK FORWARD TO AS A . . .

**FLIGHT ENGINEER**

WITH

**TWA**

- A Career with a Future
- Retirement Plan
- Annual Sick Leave
- Paid Vacation
- Group Insurance
- Liberal Free Transportation for You and Your Family Each Year



Yes, here is a career opportunity with a real future! You not only get all of these, and many more, benefits as a TWA Flight Engineer—you start out at $330 per month as a student—$485 per month as a Flight Engineer plus regular future salary increases. Beginning with the third year, Flight Engineers receive monthly base pay and guarantee of 60 hours of flight pay.

Here are the qualifications: Between the ages of 23 to 35; normally 5'7" to 6'2" inclusive; high school diploma or equivalent; pass CAA Class II physical (no waivers). Technical qualifications include: Broad A&E experience and must have CAA A&E Licenses before entering training class; pass examinations for student flight engineer.

There's a wonderful future waiting for you with TWA. Write today to Mr. R. Paul Day, Employment Manager.

**TRANS WORLD AIRLINES**
**MUNICIPAL AIRPORT**
**KANSAS CITY, MO.**



**liaison engineer for weapons systems $12,000**

General Electric's Light Military Electronic Equipment Department is organizing a team of systems evaluation engineers to support a weapons system evaluation program. The team will synthesize weapons systems and consult with design groups.

The following areas of knowledge and experience will be important in the evaluation of a prospective employee's capabilities:

- **Engineering or Physics degree.**
- **Advanced degree in mathematics, engineering or physics.**
- **Operational experience with weapons systems, aircraft or airborne electronic equipment.**
- **Responsible participation in activities for planning, development, procurement, test and evaluation of weapon systems equipment.**
- **Experience in planned advanced development study and proposal activities of military airframe and electronic producers.**

This position is in Utica, N. Y., a cosmopolitan city near the Adirondack resort area.

*Reply in confidence to:*

**Mr. John Sternberg, Dept. 863**
**Light Military Electronic Equipment Dept.**

**GENERAL ELECTRIC**

**French Road** **Utica, N. Y.**



**HELICOPTER and LIAISON AIRCRAFT MECHANICS**

Our openings offer a specialized training program to those inclined towards helicopter maintenance. We pay for your training in this remunerative and exclusive field. Those mechanics qualifying for our openings will secure excellent compensation and fringe benefits as well as area incentive allowance. A&E mechanics are preferred. However such a license is not required. Send inquiry and resume to

**LAND-AIR, INC.**
Subsidiary, California Eastern Aviation, Inc.
7444 W. Wilson Ave. Chicago 31, Ill.



*PERSONNEL MANAGERS*

**LOOKING FOR ENGINEERS . . . TECHNICIANS?**

Write for free copy of

**"RESERVOIR of ENGINEERS and TECHNICAL MEN"**

The engineers and technicians you want to reach are gathered in convenient, compact groups—as this 16-page booklet points out.

It keys the job titles these men hold to the McGraw-Hill publications they read for on-the-job information. It explains how you can make contact . . . channel, concentrate your employment advertising to just the men with the job qualifications you want . . . without wasting advertising money for higher-priced space in publications with general circulation, in which you pay for perhaps 999 unqualified readers for every 1 who may meet your job requirements.

***Write for your free copy to***
**Classified Advertising Division**
**McGraw-Hill Publishing Co., Inc.**
**P. O. Box 12, N. Y. 36, N. Y.**

## FOR RATES OR INFORMATION

About Classified Advertising,

*Contact The McGraw-Hill Office Nearest You.*

ATLANTA, 3
1321 Rhodes-Haverty Bldg
*WAlnut 5778*
R. POWELL

BOSTON, 16
350 Park Square
*HUbbard 2-7160*
H. J. SWEGER

CHICAGO, 11
520 No. Michigan Ave.
*MOhawk 4-5800*
W. HIGGENS
J. BRENNAN

CINCINNATI, 37
1825 Yorktown Road
Swifton Village, Apt. 2
G. MILLER

CLEVELAND, 15
1510 Hanna Bldg.
*SUperior 1-7000*
W. SULLIVAN

DALLAS, 2
Adolphus Tower Bldg.,
Main & Akard Sts.
*RIverside 7-5064*
D. BILLIAN

DETROIT, 26
856 Penobscot Bldg.
*WOodward 2-1793*
W. STONE

LOS ANGELES, 17
1125 W. 6 St.
*MAdison 6-9351*
C. F. McREYNOLDS
D. BRENNAN

NEW YORK, 36
330 West 42 St.
*LOngacre 4-3000*
S. HENRY
D. COSTER
R. LAWLESS
R. HATHAWAY

PHILADELPHIA, 3
17th & Sansom St.
*RIttenhouse 6-0670*
H. BOZARTH
E. MINGLE

ST. LOUIS, 8
3615 Olive St.
*JEfferson 5-4867*
W. HIGGENS

SAN FRANCISCO, 4
68 Post St.
*DOuglas 2-4600*
W. WOOLSTON



# SENIOR ENGINEERS PHYSICISTS MATHEMATICIANS

are invited to investigate challenging and creative work on

ADVANCED WEAPON SYSTEMS
ADVANCED TARGET SYSTEMS

in the recently organized Advanced Development Division of

RADIOPLANE COMPANY

Engineers with experience in Electronic and Electro-mechanical systems analysis, design and development; Aeronautical Engineers with preliminary design experience; Electronics Engineers with microwave electronics and electronic countermeasures experience;

Physicists who have worked in operations analysis, microwave electronics and radio frequency propagation phenomena;

Mathematicians who have experience in operations analysis and in digital computer problem analysis.

*We are endeavoring to staff a number of senior engineering and scientific positions. We place a premium on training and experience.*

Send complete resumes to:
Personnel Mgr., A-1
Radioplane Company
8000 Woodley Avenue
Van Nuys, California



**ENGINEERS** *with Broad Experience*

LOOK OVER THE OPPORTUNITIES IN

## DESIGN ANALYSIS

at the *Small Aircraft Engine Dept. of General Electric*

We can't think of a better way for a talented engineer with a broad background to enter the new and growing field of small aircraft engines—gas turbines with a power-weight ratio of more than 4 to 1.

The assignments are stimulating, and on advanced levels:

- Analysis of mechanical designs to determine how well they meet performance requirements.
- Analysis of the mechanical integrity of designs to ensure their suitability.
- Analysis of design concepts and techniques for the purpose of establishing design procedures and criteria.
- Study and analysis of stress and vibration characteristics of designs.

You'll have the best facilities in the field at your disposal, and gain from the experience of the men who developed the famed T-58—with its "Constant Speed Control"—new concept that threatens to revolutionize helicopter design. Advancement is rapid. Benefits are comprehensive. And you'll enjoy living within ten miles of Boston—cultural center for all New England.

*Write in complete confidence to:*
Mr. T. S. Woerz (Section R-A-7)
**SMALL AIRCRAFT ENGINE DEPT.**
**GENERAL ELECTRIC**
1000 Western Avenue West Lynn, Mass.

## SPECIAL BULLETIN:

*ENGINEERS AND SCIENTISTS*

Battelle Institute, one of the world's leading independent research organizations, has just published a new booklet describing the varied and unusual career opportunities in its laboratories. Write today for your copy, without obligation, to:

PERSONNEL MANAGER
BATTELLE INSTITUTE
COLUMBUS 1, OHIO

## YOUR ORGANIZATION

*Is it complete?*
*Are you expanding it?*
*Making Replacements?*

Naturally, you are anxious to secure the most suitable man or men available. You want men with the special training that will make them an asset to your organization. You can contact such men through an advertisement in the Employment Opportunities Section of AVIATION WEEK.

*Classified Advertising Division—*

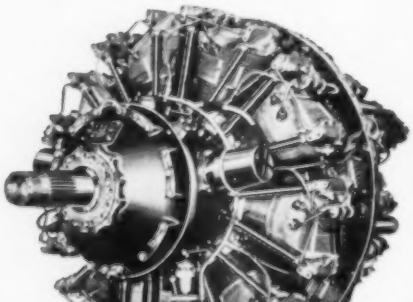
**AVIATION WEEK**
330 W. 42nd St.,
New York 36, N. Y.

## CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

# WRIGHT—P&W
## ENGINES & PARTS

R1820
R1830
R2600
R2800
R3350



CALIFORNIA AIRMOTIVE • CORPORATION

7139 Vineland Avenue,
North Hollywood, California
POplar 5-6202
STanley 7-8374

**Deal Directly with Owner**
Executive style 6 passenger cabin
Immediately available
Fly as much as you like
No long term contract required

**1951 Executive Dove**
*FOR LEASE*
**$1000 monthly**

At this very low rate it will pay you to lease instead of own. We pay hull insurance, lessee pays maintenance, operating cost, engines. Option to purchase may also be arranged with lease payments applicable.

TRADE-AYER COMPANY
Linden Airport, Linden, N. J.
A. J. Ming — Hunter 6-7690

**NAVCO,** inc.
Lambert Field
St. Louis, Mo.
PErshing 1-1710
*has factory fresh, dated*
**DEICER BOOTS**
DC3 Lodestar Beech

**F 51-D**
North American Fighter Planes,
limited quantity
*Sell, trade or lease*
STINSON FIELD AIRCRAFT
P. O. Box 1738 San Antonio, Texas
CApital 4-8434

**HELICOPTER**
Hiller—Model UH-12B. Very low airframe and engine time.
*Perfect Condition.*
EAST COAST AVIATION CORPORATION
Bedford Airport Lexington 73, Mass.

**SPECIAL SERVICES**

TO THE

**AVIATION INDUSTRY**

**Immediate Delivery**

We stock, overhaul, and install

PRATT & WHITNEY R1830 –75, –92, –94

WRIGHT R1820 –202, –56, –72

R985 R1340 R2000

and our most popular DC3 engine

R1830 - SUPER - 92

**ENGINE WORKS**

Lambert Field Inc. St. Louis, Mo.

WORLD'S FOREMOST

**LODESTAR**

SERVICE CENTER

Inspection, Maintenance, Instrumentation, Modification, Overhaul

Radar, Interiors, Engine Change, Exteriors, Radio

**LEAR**

AIRCRAFT ENGINEERING DIVISION

Santa Monica Airport, Santa Monica, California

Builders of the Incomparable Learstars

**CONNECTORS**

STOCK DELIVERY—AUTHORIZED DISTRIBUTOR

BENDIX CANNON DAGE IPC WINCHESTER

2102 Market St., Phila. 3, Pa., LO 7-5285

HAROLD H. POWELL CO.

Deal Directly with Owner

**HANGARS**

U.S. Navy type. 120' clear span by 200' depth Doors 120'x28'

All Steel Constructed. Excellent monetary saving and good delivery if you are considering the construction of a hangar of this size.

TRADE-AYER COMPANY

Linden Airport Linden, N. J.

Hunter 6-7690

7 TO 10 DAYS' INSTALLATION

Bendix Collins R.C.A. **RADAR** X-Band or C-Band

CORRECT RADOMES for X or C BAND

Only R/W has the reinforced double-shell dielectric radome recommended for X-Band—high transmission efficiency and high structural strength with no *compromise* or loss—*no restrictions* of air speed or any kind. Weather-tight fitting, leakproof, quiet. Won't vibrate loose. Lowest installation cost.

Separately hinged radome and scanner, for easy disconnect and adjusting—*necessary for accurate antenna tuning.* Quick access to instrument panel.

**Remmert-Werner**

Inc. of St. Louis, Lambert Field

Inc. of Florida, Pompano Beach

Inc. of Toledo, Express Airport

Lodestar DC3 Beech

Specialists in Conversion Maintenance Overhaul

*IF YOU RENDER A SERVICE TO THE AVIATION INDUSTRY YOU SHOULD INQUIRE ABOUT THIS SECTION!*

Write

Classified Advertising Division

330 W. 42 St., New York 36, N. Y.

**PROFESSIONAL SERVICES**

KIRBY AND COPE ASSOCIATES

HUMAN FACTORS

Consultation on the design and utilization of mechanical and electrical equipment to suit man's physiological and psychological capabilities. Specialists in the cross-application of physical science and engineering with biology, medicine and psychology.

1515 Ramblewood Road Baltimore 12, Md.

Tel. ID 3-3609 or PE 2-8839

**DC-3 FOR SALE**

We are owners.

LEEWARD AERONAUTICAL SALES, INC

P.O. BOX 233, MIAMI 48, FLA.

Consult these Specialists

when you need professional assistance in solving difficult problems. Their specialized knowledge and broad experience can prove invaluable in saving both time and money for you.

*When You Need Quick Action*

*on Opportunities available or wanted in Aviation Week . . . USE*

The Searchlight Section

keep your weather eye out for

*Weather Eye*

smaller lighter Flight RADAR

custom fitted to your plane

P. O. Box, Bridgeton, Mo.

**FOR SALE**

**Three HS Sikorski Helicopters with large inventory parts.** Stinson Field Aircraft P. O. Box 1738 San Antonio, Texas. CApital 4-8434.

**New Bell 47 D&G Helicopter parts. ½ off list.** Stinson Field Aircraft P. O. Box 1738 San Antonio, Texas. CApital 4-8434.

**C-125 Northrop Trimotor Plane, excellent** condition, low time. Sell or trade. Stinson Field Aircraft P. O. Box 1738 San Antonio, Texas. CApital 4-8434.

**F-51-D North American Fighter Planes, limited** quantity, low time, excellent condition, ready to go. Sell trade or lease. Stinson Field Aircraft P. O. Box 1738 San Antonio, Texas. CApital 4-8434.

BAS INCORPORATED

*"Take a Heading for Reading"*

*for the BEST MAINTENANCE • OVERHAUL • MODIFICATION • INSTALLATION*

READING AVIATION SERVICE, INC.

Municipal Airport Phone 3-5255 Reading, Pennsylvania

• COLLINS
• BENDIX
• SPERRY
• LEAR
• ARC

*Page* AIRWAYS INC.

ROCHESTER AIRPORT

PHONE GENESEE 8-7301

ROCHESTER 11, N.Y.

RADAR

AUTOMATIC PILOTS

NAVIGATION AND

COMMUNICATION SYSTEMS

**FLY FRIENDSHIP AIRPORT**

TO WASHINGTON—BALTIMORE

40 min. to Wash. — 20 min. to Balto.

Complete facilities — no waiting

Contact us for car, limo, & hotel reservations.

PAN-MARYLAND AIRWAYS, INC.

Friendship Airport, Md.

CAA certified repair station

# 3-Day Public AUCTION

## OVER $18,000,000 AIRCRAFT SUPPLIES, PARTS & EQUIPMENT

INVENTORY REDUCTION

—for—

## AMERICAN AIRMOTIVE CORP.

Miami International Airport

## MIAMI, FLORIDA

—on—

## DECEMBER 11, 12, 13

$3,778,000 Acquisition Cost
**MAGNETOS AND PARTS, ETC.**
*American Bosch, Scintilla and General Electric*

$2,195,000 Acquisition Cost
**AN HARDWARE & FITTINGS**

$2,795,000 Acquisition Cost
**STARTERS & GENERATORS, PUMPS, MISC. PARTS, ETC.**
*Eclipse, Leece-Neville, Thompson, Pesco, Romex, Adel, Chandler-Evans*

$685,500 Acquisition Cost
**RADIO, ELECTRONIC SUPPLIES PARTS & MISC. EQUIPMENT**

$956,600 Acquisition Cost
**INSTRUMENTS, INDICATORS, GAUGES AND METERS, ETC.**

$1,805,400 Acquisition Cost
**ELECTRICAL EQUIPMENT & MISCELLANEOUS SUPPLIES**

$759,000 Acquisition Cost
**SHOP AND HAND TOOLS, MACHINERY & EQUIPMENT**

$5,500,000 Acquisition Cost
**MISC. AIRCRAFT SUPPLIES**

## NO RESERVE OR MINIMUM PRICES

**ON DISPLAY**
For inspection from Monday, Dec. 3rd, incl. Saturday and Sunday from 9 a.m. to 4:30 p.m. Daily . . . . . UNTIL SOLD

**CATALOGS**
Mailed Free Upon Request . . . . Wire, Write or Phone Auctioneers . . . . Catalogs Also Available at Auction Inspection Building #145.

**PLAN *NOW* TO ATTEND**

*Arranged and conducted by*

**ROSS & ROSS AUCTIONEERS, INC.**

Main Offices: Wooddale Bldg.
MINNEAPOLIS 16, MINN.
Phones: WAlnut 7-9997

**TERMS**
⅓ Down by Cash, Cashier or Certified Checks Made Payable to . . . ROSS & ROSS AUCTIONEERS, INC. Company Checks Accepted ONLY When Accompanied by An Official Letter of Credit from Bank.

**IN MIAMI**
For further information in Miami, Contact: Mr. John Allem . . . . TUxedo 8-8411



## *USE NATIONAL CLASSIFIED ADVERTISING*

for bringing business needs or opportunities to the attention of men associated in administrative, executive, management, sales and responsible technical, engineering and operating capacities within the industries served by Aviation Week. For advertising rates or other information write:

**Classified Advertising Division**
**Aviation Week, 330 West 42nd St., New York 36, N. Y.**



U. S. GOVT.

# ELECTRONIC

## INVENTORY TERMINATIONS

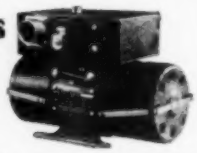
*at tremendous savings!*

### 3-AXIS LEAR AUTOPILOT GYRO AND AMPLIFIER

component control type W-2 mfr's part No. 82455

This is the famous autopilot used on the F86 aircraft. Unit contains two gyros: a vertical and a directional mfgd. by Minneapolis-Honeywell. Unit also contains 5 plug-in Servo amplifiers, with a total of 30 tubes. Unit is in excellent condition, removed from the aircraft. Approximate Government cost $8,000.00. Limited quantity available at **$250.00** each

### INVERTERS



10042-1-A Bendix
DC Input 14 volts; output: 115 volts; 400 cycles. 1-phase; 50 watt **$35.00**

12116-2-A Bendix
Output: 115 VAC; 400 cyc; single phase; 45 amp. Input: 24 VDC, 5 amps. **$35.00**

12117 Bendix
Output: 26 volts; 400 cycles, 6 volt amperes, 1 phase. Input: 24 VDC; 1 amp. **$15.00**

12119-1 Bendix
Output: 26 volts, 400 cycle, 6 voltamp. 1 phase. Input: 12 VDC. **$17.50**

F16-2 Jack & Heintz
Output: 115 volts, 400 cycle, 3 phase, 250 VA pf .9. Input: 27.5 volts, 20 amp. Electronic frequency and voltage regulated. **$150.00**

12121 Bendix
Input: 24 volt D.C. 18 amp. 12000 r.p.m. Output: 115 volts, 400 cycle, 3-phase, 250 volt amp, 7 pf. **$49.50**

12147-1 Pioneer
Output: 115 VAC 400 cycles; single phase. Input: 24-30 VDC; 8 amps. **$39.50**

778 Bendix
Output: 115 volt, 400 cycle; 190 VA; single phase and 26 volt, 400 cycle, 60 VA, single phase. Input: 24 VDC. **$37.50**

10285 Leland
Output: 115 volts AC; 750 VA, 3 phase, 400 cycle, .90 pf and 26 volts. 50 VA, single phase, 400 cycle, .40 pf. Input: 27.5 VDC. 60 amps. cont. duty, 6000 rpm. Voltage and frequency regulated. **$59.50**

10339 Leland
Output: 115 volts; 190 VA; single phase; 400 cycle; .90 pf. and 26 volts; 60 VA; 400 cycle, .40 pf. Input: 27.5 volts DC, 18 amps cont. duty, voltage and freq. regulated. **$49.50**

10486 Leland
Output: 115 VAC; 400 cycles; 3-phase; 175 VA; .80 pf. Input: 27.5 DC; 12.5 amps; cont. duty. **$70.00**

10563 Leland
Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 pf. Input: 28.5 VDC; 12 amps. **$35.00**

MG149F Holtzer-Cabot
Output: 26 VAC @ 250 VA; 115 V. @ 500 VA; single phase; 400 cycle; Input: 24 VDC @ 36 amps. **$40.00**

940702-1 Eicor, Class "A"
Input: 27.5 volts at 9.2 amps. AC. Output: 115 volts 400 cycles; 3 phase 100 voltamp; continuous duty. Price **$39.50** each

**C & H SALES CO.**
2174 E. Colorado St. • Pasadena, Calif.

# LACROSSE MISSILE SYSTEM

## RESEARCH AND DEVELOPMENT BY CORNELL AERONAUTICAL LABORATORY

Cornell-created from the preliminary design stage to the point of final development, the Lacrosse guided missile system has been released by the Army for production at the Glenn L. Martin Co.

Now, the guided missile becomes a field weapon for the close support of infantry operations. With Lacrosse, our front-line soldier will have a deadly surface-to-surface guided missile system, with the mobility of a truck-mounted launcher and accuracy enhanced by its own guidance station. Its price tag to its present stage has been one of the lowest in missile-systems history.

Justly proud of a job well done, C.A.L. now moves on to new aeronautical frontiers—to more research in weapon systems, missile and aircraft design, electronics, gasdynamics, high temperature problems, hypersonics, and other challenging areas of modern flight.

We invite you to investigate the opportunities in research available at C.A.L. for the professional man. Write today—your inquiry will receive prompt and confidential attention.

**CORNELL AERONAUTICAL LABORATORY, INC.**
*OF CORNELL UNIVERSITY*

## WRITE FOR FREE REPORT

The story behind Cornell Aeronautical Laboratory and its contributions to aeronautical progress is vividly told in a 68-page report, "A Decade of Research." Whether you are interested in C.A.L. as a place to work or as a place to watch, you will find "A Decade of Research" both useful and pertinent. Mail in the coupon now for your free copy.

W. V. DIEFENBACH
**CORNELL AERONAUTICAL LABORATORY, INC.**
Buffalo 21, New York

Please send me a copy of "A Decade of Research."

Name _____

Street _____

City _____ Zone _____ State _____

☐ Please include employment information.

# Solar skills give power and form to new missile programs

**FROM THE EARLIEST DAYS** of United States missile development, Solar has contributed to both propulsion and fuselage programs. Today, with expanded engineering, development and production organizations and facilities, Solar is well equipped to assume major responsibilities in new missile projects.

Solar built the first Corporal missile motor—and today Solar is building complete fuselages for the Hughes Falcon. These examples indicate the range of Solar activities—and they are tied together by the company's three decades of experience in high temperature metallurgy.

A new brochure on Solar's missile production capabilities is available. For your copy, please address Dept. C-103, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, Calif.

**SOLAR**
**AIRCRAFT COMPANY**
SOLAR
SAN DIEGO DES MOINES

**ENGINEERS WANTED** *Unlimited opportunities in Solar's expanding gas turbine program! Write today, giving experience.*

# ADVERTISERS IN THIS ISSUE

## AVIATION WEEK, NOVEMBER 26, 1956


AERO DESIGN & ENGINEERING COMPANY..... 98
Agency—Tom P. Gordon Co., Adv.
AEROJET-GENERAL CORPORATION.....60, 61
Agency—D'Arcy Adv. Company
AIRCRAFT EQUIPMENT TESTING COMPANY..... 52
Agency—Mahool Advertising, Inc.
AIRWORK CORPORATION.....82, 83
Agency—Gene Wyble Advertising
AMERICAN AIRLINES, INC..... 42
Agency—Lennen & Newell, Inc.
AMERICAN CHAIN & CABLE, AUTOMOTIVE & AIRCRAFT DIV.....103
Agency—Reincke, Meyer & Finn, Inc.
AVIATION WEEK.....96, 97

BENDIX RADIO DIV., BENDIX AVIATION CORP. 6
Agency—MacManus, John & Adams, Inc.
BENTLEY, HARRIS MANUFACTURING COMPANY 83
Agency—Williams Jenkins Adv., Inc.
BRIDGEPORT BRASS COMPANY (ALUMINUM DIV.) ..... 78
Agency—Hazard Advertising Company, Inc.
BRUNSWICK-BALKE-COLLENDER CO., THE ..64, 65
Agency—McCann-Erickson, Inc.

CALIDYNE COMPANY, THE..... 66
Agency—Meissner & Company, Inc.
CAMLOC FASTENER CORPORATION..... 58
Agency—Lewis Advertising Agency
CESSNA AIRCRAFT COMPANY..... 46
Agency—Gardner Advertising Co.
CESSNA AIRCRAFT COMPANY.....100
Agency—Lage & Whitehead Ads.
CONNECTICUT HARD RUBBER COMPANY..... 84
Agency—Froland, Inc.
CONSOLIDATED ELECTRODYNAMICS CORPORATION ..... 11
Agency—Hixson & Jorgensen, Inc.
CORNELL AERONAUTICAL LABORATORY, INC...119
Agency—Barber & Drullard, Inc.
CRAIG SYSTEMS, INC..... 71
Agency—Larcom Randall Adv.

deHAVILLAND AIRCRAFT OF CANADA LTD., THE ..... 11
Agency—Paul Phelan Adv. Ltd.
DOW CHEMICAL COMPANY..... 20
Agency—MacManus, John & Adams, Inc.

EX-CELL-O CORPORATION..... 59
Agency—Holden-Chapin-Larue, Inc.

FAIRCHILD ENGINE & AIRPLANE CORP. (AIRCRAFT DIV.)..... 102
Agency—Gaynor, Colman, Prentis & Varley, Inc.
FASTENERS, INC..... 92
Agency—Doyle, Kitchen & McCormick, Inc.

GENERAL ELECTRIC COMPANY.....8, 9
Agency—G. M. Basford Company
GENERAL ELECTRIC CO., ELECTRONICS COMPONENTS DIV..... 16
Agency—Maxon, Inc. Adv.
GLADDEN PRODUCTS CORPORATION..... 95
Agency—Weir Advertising
GOODYEAR TIRE & RUBBER CO., INC..... 3
Agency—Kudner Agency, Inc.

HARNISCHFEGER CORP. WELDING DIV..... 72
Agency—Hoffman & York, Inc.
HEINEMANN ELECTRIC CO..... 79
Agency—Thomas R. Sundheim Adv.
HYDRO-AIRE, INC..... 13
Agency—Byron H. Brown & Staff, Inc.

INTERNATIONAL ELECTRONIC RESEARCH CORP. ..... 80
Agency—Jayerart Co. Adv.

JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY.....121
Agency—M. Belmont Ver Standig

KAISER ALUMINUM & CHEMICAL SALES, INC. .....53, 54, 55, 56
Agency—Young & Rubicam, Inc.
KELSEY-HAYES WHEEL CO..... 36
Agency—Zimmer, Keller & Calvert, Inc.

LAVELLE AIRCRAFT CORP..... 5
Agency—The Roland G. E. Ullman Organization
LEACH RELAY CO., DIV. OF LEACH CORP. ..... Third Cover
Agency—Hixson & Jorgensen, Inc.
LEWIS ENGINEERING COMPANY, THE..... 82
LIBRASCOPE, INCORPORATED..... 18
Agency—Western Advertising Agency, Inc.
LOCKHEED AIRCRAFT CORP. (CALIFORNIA DIV.) .....105
Agency—Hal Stebbins Ads.

MALLORY-SHARON TITANIUM CORPORATION...104
Agency—The Griswold-Eshleman Co.
MARQUARDT AIRCRAFT COMPANY.....106
Agency—Heintz & Co., Inc.
MARTIN CO., THE GLENN L..... 24
Agency—Vansant, Dugdale & Co., Inc.
MINNEAPOLIS-HONEYWELL REGULATOR CO. (AERONAUTICAL DIV.) .....74, 75
Agency—Foote, Cone & Belding
MISSILE DIV. NORTH AMERICAN AVIATION INC. ..... 90
Agency—Batten, Barton, Durstine & Osborn, Inc.
MIT INSTRUMENTATION LABORATORY..... 93
Agency—Allied Adv.
MONSANTO CHEMICAL CO..... 86
Agency—Gardner Advertising Co.

PACIFIC DIV., BENDIX AVIATION CORP..... 68
Agency—The Shaw Company Adv.
PACIFIC SCIENTIFIC CO..... 87
Agency—The Martin R. Klitten Co., Inc.
PASTUSHIN INDUSTRIES, INC..... 85
Agency—Western Adv. Agency, Inc.
PIONEER CENTRAL DIV. OF BENDIX AVIATION CORP..... 88
Agency—MacManus, John & Adams, Inc.
PITTSBURGH PLATE GLASS CO. (SAFETY GLASS) ..... 70
Agency—Batten, Barton, Durstine & Osborn, Inc.

RED BANK DIV., BENDIX AVIATION CORP..... 89
Agency—MacManus, John & Adams, Inc.
RESEARCH WELDING & ENGINEERING CO., INC. ..... 74
Agency—Dan Ebberts Adv. Service
ROBINSON CO., RALPH C..... 83
Agency—Chapin-Damm Adv.
ROCKETDYNE A DIV. OF NORTH AMERICAN AVIATION, INC..... 50
Agency—Batten, Barton, Durstine & Osborn, Inc.
ROHR AIRCRAFT CORPORATION..... 63
Agency—Barnes Chase Co.
ROLLS-ROYCE LTD..... 44
Agency—The Wesley Associates Adv.
RYAN AERONAUTICAL COMPANY..... 94
Agency—Batten, Barton, Durstine & Osborn, Inc.

SAGINAW STEERING GEAR DIV., GENERAL MOTORS CORP. ..... 15
Agency—D. P. Brother & Co.

SCOTT AVIATION CORP..... 67
Agency—Melvin F. Hall Adv. Agency, Inc.
SARCHLIGHT SECTION.....107-118
SERVICE STEEL DIV., VAN PELT CORP.....101
Agency—Claude E. Whipple Adv.
SERVOMECHANISMS, INC.....Fourth Cover
Agency—Sanger-Funnell, Inc.
SOLAR AIRCRAFT COMPANY.....120
Agency—The Phillips Ramsey Co. Adv.
SPENCER THERMOSTAT DIV., METALS & CONTROLS CORP. ..... 81
Agency—Sutherland-Abbott Adv.
STEWART WARNER CORP. (ELECTRONICS DIV.) ..... 17
Agency—The Buchen Company
STILLMAN RUBBER CO..... 66
Agency—Lynn-Western, Inc.
STRATOS DIV. OF FAIRCHILD ENGINE & AIRPLANE CORP. ..... 35
Agency—Gaynor, Colman, Prentis & Varley, Inc.
STROUKOFF AIRCRAFT CORP..... 10
Agency—J. Wheelock Associates
SUNDSTRAND MACHINE & TOOL CO., AVIATION DIV. ..... Second Cover
Agency—Howard H. Monk & Associates, Inc.

THERM-ELECTRIC METERS CO., INC..... 57
Agency—Taylor M. Ward, Inc.
TWIN COACH CO., AIRCRAFT DIV..... 7
Agency—Palm & Patterson, Inc.

UNITED STATES STEEL CORP.....48, 49
Agency—Batten, Barton, Durstine & Osborn, Inc.

VICKERS, INC., DIV. OF SPERRY RAND CORP.... 12
Agency—Witte & Burden Adv.

WEBER AIRCRAFT CORP..... 4
WHITTAKER GYRO DIV. OF TELECOMPUTING CORP. .....101
Agency—Mogge-Privett, Inc.
WYMAN GORDON CO..... 22
Agency—John W. Odlin Co., Inc.


### CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.


EMPLOYMENT OPPORTUNITIES.....107-116

NOTICES
Auction .....118

EQUIPMENT
(Used or Surplus New)
For Sale.....116-117-118


### ADVERTISERS INDEX


BATTELLE MEMORIAL INSTITUTE..... 116
C & H SALES CO..... 118
CALIFORNIA AIRMOTIVE CORP..... 116
CESSNA AIRCRAFT CO..... 113
CHANCE VOUGHT AIRCRAFT..... 109
EAST COAST AVIATION CORP..... 116
ENGINE WORKS..... 117
FARNSWORTH ELECTRONICS CO..... 112
FIDELITY PERSONNEL SERVICE..... 112
FRIENDSHIP AIRPORT..... 117
GENERAL ELECTRIC CO., WEST LYNN.....110-115
GENERAL MOTORS CORP..... 111
GOODYEAR AIRCRAFT CORP..... 107
HELIPOT CORP..... 113
KIRBY & COPE ASSOCIATES..... 117
LAND-AIR INC..... 114
LEAR INC..... 117
LEEWARD AERONAUTICAL SALES, INC..... 117
MARTIN CO., GLENN L..... 108
McDONNELL AIRCRAFT CORP..... 112
MOTOROLA INC..... 110
NAVCO, INC..... 116
PAGE AIRWAYS, INC..... 117
PIPER AIRCRAFT CORP..... 112
POWELL CO., HAROLD H..... 117
PREWITT AIRCRAFT CO..... 113
RADIOPLANE CO..... 115
REACTION MOTORS, INC..... 108
READING AVIATION SERVICE INC..... 117
REMMERT WERNER, INC..... 117
ROSS & ROSS AUCTIONEERS..... 118
ROTOR-AIDS, INC..... 112
STINSON FIELD AIRCRAFT..... 116
TRADE-AYER CO..... 116-7
TRANS-WORLD AIRLINES..... 114
WEATHER EYE..... 117



ENGINEERS
*Aerodynamics & Propulsion*

## APL-An Organization Of And For Technical Men And Scientists

The Applied Physics Laboratory, (APL) of the Johns Hopkins University is an organization of and for technical men and scientists. APL is organized on a horizonal **basis**; responsibility and authority are given in equal measure. Scientists and technical men occupy all decision-making positions, because our **only** objective is technical progress.

Because of its predominantly professional character, APL has kept in the vanguard, having pioneered the proximity fuze, the first supersonic ramjet engine, the Navy's Bumblebee family of missiles which includes the TERRIER, TALOS and TARTAR, and is presently attempting break-throughs on several important fronts.

Occupying a site equidistant from Washington, D. C. and Baltimore, Maryland, APL's new laboratories allow staff members to select urban, suburban or rural living, and either of these outstanding centers of culture as a focal point for fine living. Salaries compare favorably with those of other R & D organizations.

**OPENINGS EXIST IN:**

**DEVELOPMENT:** Stability and control analysis; ramjet engine design; preliminary design and wind-tunnel testing.

**RESEARCH:** Interference and heat transfer phenomena; internal aerodynamics; hypersonics, turbulence, shock wave phenomena; combustion.

Write for complete information. Your letter will be answered personally, in detail.

*Write: Professional Staff Appointments*

The Johns Hopkins University
Applied Physics Laboratory

8615 Georgia Avenue, Silver Spring, Md.

# LETTERS

## Shares NACA Feeling

Your Nov. 5 editorial tribute to the NACA and the men who make it tick gave effective voice to sentiments widely shared in the aircraft industry but all too rarely expressed.

We in the business realize what a primitive state our military and commercial aviation would be in today had it not been for NACA. Yet the importance of this agency has never been adequately appreciated by the general public or by Congress.

I sincerely hope copies of your editorial will be given wide distribution among members of Congress, the Bureau of the Budget, the Selective Service System, the Civil Service Commission, and (if this be treason . . . etc.) college placement offices.

G. G. Kayten
Chief Aerodynamics Engineer
The Glenn L. Martin Co.
Baltimore 3, Md.

## Lauds Algeria Series

I was fortunate enough to be the only American representative on hand during both phases of the recent evaluation of the H-21 and H-34 in Algeria. In between the phases, I concentrated my activities at the Army base at Setif.

I wish to say at this time that it is my personal belief Robert Farrell has done a magnificent job of reporting on a quite abstract subject. In reading the articles (AW Sept. 17, p. 28, Sept. 24, p. 88, and Oct. 1, p. 73), I found practically no items I would have covered in a substantially different manner than did Mr. Farrell.

Frequently when reading a news or narrative article on a subject with which I am intimately familiar I find the author has not gathered all the facts or has drawn what I consider to be improper conclusions based on his interpretation of the facts he has obtained. This is certainly not the case in Mr. Farrell's Algerian report.

Congratulations on an excellent presentation. It is through fine articles like this that I repeatedly find Aviation Week is the most valuable aviation periodical to reach my desk.

T. R. Pierpoint
Service Manager
Vertol Aircraft Corp.
Morton, Pa.

## Altimeter Ready Now

In your Oct. 22 issue (p. 154) Mr. Robert E. Trimble expresses the hope that someone 'comes up with' an accurate altimeter before the 1,000 ft. on top clearance is eliminated.

The purpose of this letter is to draw to Mr. Trimble's attention, as well as the attention of your many other readers who must have observed Mr. Trimble's comments, that someone has "come up with" an accurate altimeter. As a matter of fact, two recent improvements in altimeters made by the Kollsman Instrument Corp. have come a long way toward eliminating the conditions described in Mr. Trimble's letter.

***Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.***

In your Mar. 5 issue (p. 69) a description of the Kollsman Integrated Flight Instrument System pointed out that altitude information was given by the system within an accuracy of plus or minus 100 ft. at 40,000 ft. Although this is a commercial development and the system was designed primarily for, and in conjunction with, the scheduled airlines, there is no reason why other aircraft, such as the military, could not use this equipment. Secondly, the new altimeters designed to the new precision specifications go a long way toward removing instrument error.

Of course, having an accurate instrument is only part of the story. For example, I am sure that if Mr. Trimble's correspondent were to investigate further he would find that most of the variation in altimeter readings experienced by the eight F-80s flying at 36,000 ft. were caused by variations in the static systems of the airplanes, and a relatively small amount by the variations in the instruments themselves. This is where the new Kollsman Integrated Flight Instrument System comes into its own. Through the use of this system the errors in the static system as well as variations within the instruments are corrected.

I am in complete sympathy with Mr. Trimble's thoughts in this matter, but now that the equipment has been designed and is in production it's up to the operators to see that the proper use is made of it.

Everett H. Schroeder
Kollsman Instrument Corp
Elmhurst, N. Y.

## Passenger Delay

Just a line to congratulate you on your editorial of Oct. 8 (Passenger Service Pays Off). Perhaps this will help the exasperating problem of just letting people wait. Maybe more airlines will like to see the good publicity. Last week I was disgusted with transfer from Madrid at Idlewild; a long delay and they wouldn't let passengers back off the plane.

John M. Hanson
Hoover Electronics Co.
Baltimore, Md.

## Heat Exchanger

Your article "Heating Studies Tax Apparatus Ingenuity" (AW Oct. 29, p. 46) describes a ceramic heat exchanger being constructed by the NACA and describes the pilot model of the heat exchanger. It is of interest to note that a full scale ceramic heat exchanger which has operated at 2,500F has been in successful operation at the hypersonic facility of the Polytechnic Institute of Brooklyn for the past two years. A 12-in. jet of air with velocity exceeding 6,000 fps. at a total stream temperature of 2,500F can be produced. (See for reference, WADC-TN 55-695, November 1955, and The Proceedings of the High-Speed Conference on Aeronautics, Polytechnic Institute of Brooklyn, 1955).

This heater, conception and construction of which was sponsored by the Aeronautical Research Laboratory of the Wright Air Development Center, USAF, is believed to have been the first of its kind in operation in connection with hypersonic wind tunnels. It is gratifying to see that this successful pioneering effort has influenced the construction and use of similar heat exchangers for this purpose in other facilities in the United States.

Martin H. Bloom
Associate Professor
Aeronautical Engineering
Polytechnic Institute of Brooklyn
Freeport, N. Y.

## Utter Disregard

Such disgusting irresponsibility can no longer pass without protest (AW Sept. 10, p. 23, Industry Observer).

No civil pilot, even one flying someone else's equipment, would dare show such utter disregard for the aircraft or the safety of lives and property at his destination.

Instead of being lauded for a brilliant performance, the Air Force personnel involved in the arrival of F-100C aircraft in the Bendix Trophy Race with no fuel or with only 20 gallons left in the tank must be strongly criticized.

A gamble of this sort with several million dollars worth of taxpayers' airplanes (in the presence of absolutely no military necessity) can not be justified.

Are we to assume that the pilots are not familiar with the fuel consumption of their aircraft, or that the people responsible for permitting their participation do not care about these factors, or the need for these airplanes in our national defense effort?

Much more than a wrist slapping is required here. Such criminal disregard for safety of persons, property, and taxpayers' aircraft, needed for our defense, must never be repeated.

Jim Fitzhugh
San Diego, Calif.

## Britannia Error

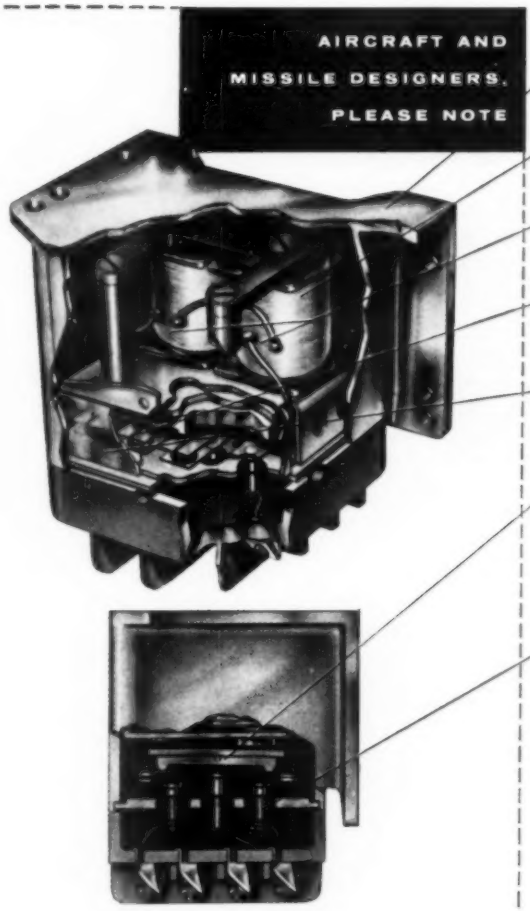
In your issue of Aug. 20 (p. 23) it is stated that "maximum letdown rate for the Bristol Britannia is limited to 500 fpm. . .". I am afraid this is very wide of the mark. We recommend that, with the Britannia 310, operators can schedule a rate of descent of 2,000-2,500 fpm. The corresponding rate in the cabin is, of course, only equivalent to 200-300 fpm.

A point of interest is that, during its tour of North America, the Britannia 102 regularly descended at up to 2,000 fpm when following airline let-down procedures.

Peter King
The Bristol Aeroplane Company Ltd.
Bristol, England

*Get unprecedented performance—*

# See for yourself why the new LEACH BALANCED-ARMATURE RELAYS outperform all other types in resistance to shock, acceleration and vibration




**ONE-PIECE DIE CAST ALUMINUM HOUSING** for maximum strength and vibration resistance with minimum weight.

**MAGNET COIL** wound with Teflon insulated magnet wire on one-piece Kel F bobbin assures reliability at elevated ambients.

**DUAL COIL** construction is the most efficient magnetic circuit for minimum height and maximum resistance to vibration and shock.

**BIFURCATED CONTACTS** assure high reliability in contact making circuits. Overtravel and high contact pressures produced by the pivoted armature result in immunity to shock and vibration.

**ARC BARRIER** of Kel F molded construction provides long arc path for use on 3 phase ac circuits, prevents phase-to-phase flashover.

**BALANCED-ARMATURE DESIGN.** In a *Balanced-Armature* construction, shock and vibration forces cannot cause the relay armature to move. This eliminates faulty operation of contacts due to vibration and shock forces.

**HEADER AND CONTACT ASSEMBLY** features simplified construction which eliminates internal wiring, lowers lead resistance, provides maximum resistance to vibration. Contacts and working parts are readily accessible throughout assembly, so that Leach is able to measure contact gap, contact pressure and overtravel, prior to sealing, on 100 per cent of production. Customers are assured of maximum performance from every production relay. Patent Pending.

## MEETS ALL REQUIREMENTS OF THE MOST EXACTING OPERATING ENVIRONMENTS

The Leach Balanced-Armature Relays meet or exceed requirements of MIL-R-5757, MIL-R-6106, MIL-E-5272. Typical ratings include: vibration, 20 G's to 500 cps (higher ratings available); shock and acceleration, more than 50 G's; temperature, −50° to +125°C; life, 50,000 continuous operations minimum at rated load; coils, any resistance to 10,000 ohms—also available for 115 vac, 400 cps operation.

*Write today for your copy of the Leach Balanced-Armature Relay Catalog.*

**LEACH** CORPORATION | LEACH RELAY DIVISION

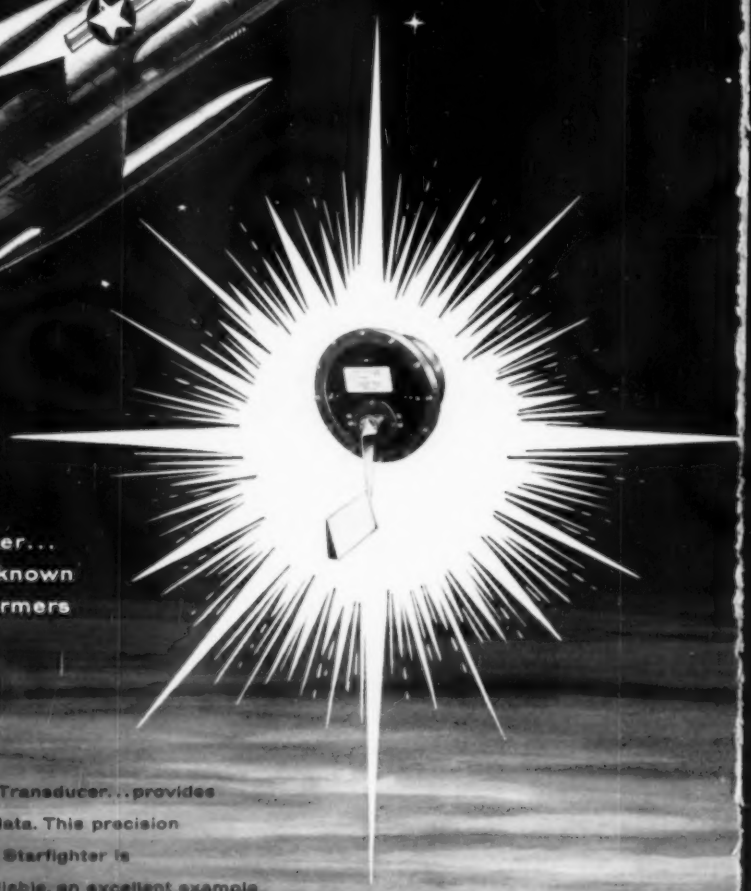
5915 AVALON BOULEVARD, LOS ANGELES 3, CALIFORNIA

DISTRICT OFFICES AND REPRESENTATIVES IN PRINCIPAL CITIES OF U. S. AND CANADA

E B POWER GS
UNIVERSITY MICROFILM INC
313 N 1ST ST
ANN ARBOR MICH

# Star Performers...

Lockheed's F-104 Starfighter... the fastest combat aircraft known ...another of the star performers in the Air Force's famed "Century" series.



Servomechanisms' Relative Wind Transducer...provides angle of attack and stall warning data. This precision instrument selected for use in the Starfighter is extremely accurate, rugged and reliable, an excellent example of the advanced equipment Servomechanisms builds for today's high performance aircraft.

**SERVOmechaNISMS INC.**

WESTERN DIVISION, Hawthorne, California
EASTERN DIVISION, Westbury, L. I., New York
MECHATROL DIVISION, Westbury, L. I., New York
MECHAPONENTS DIVISION, Hawthorne, California